A COMPARATIVE STUDY ON THE IMPACT OF ICT INTEGRATION ON TEACHERS' PEDAGOGICAL PRACTICES BY ICT AND NON-ICT TRAINED TEACHERS IN SECONDARY SCHOOLS IN MACHAKOS COUNTY, KENYA.

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DECLARATION

This thesis is my original work and has not been presented for a degree award in any other University.

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I dedicate this PhD thesis to my late Dad and Mum; Mr. Jacob K. Makanga and Mrs. Monicah M. Kithungu.

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ABBREVIATIONS AND ACRONYMS

CAA	Computer Assisted Assessment
CAT	Continuous Assessment Tests
CATs	Classroom Assessment Techniques
CD	Compact Disc
CDE	County Directors of Education
CDTM	County Director Teacher Management
CQASO	County Quality Assurance and Standards Officer
DIT	Diffusion of Innovation Theory
DVD	Digital Video Display
HODs	Heads of Departments
ICT	Information Communication Technology
ICTs	Information Communication Technologies
ICTLT	International Conference on Teaching and Learning with Technology
ISTE	International Society for Technology in Education
KICD	Kenya Institute of Curriculum Development
LCD	Liquid Crystal Display
LMS	Learning Management Systems
MOE	Ministry of Education
MOICT	Ministry of Information Communication and Technology
NACOSTI	National Council of Science Technology and Innovation
PDEDs	Personal Digital Entertainment Devices
SDGs	Sustainable Development Goals
SLOs	Student Learning Outcomes

SPSS	Statistical Package for Social Sciences
TSC	Teachers Service Commission
TV	Television
UNESCO	United Nations Educational, Scientific and Cultural Organization

ABSTRACT

The aim of this study was to investigate the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. The study was steered by four objectives which focused on the impact of ICT integration on content preparation, content delivery, content assessment, and teacher-learner interaction by ICT and Non-ICT trained teachers in secondary schools. The study reviewed relevant research literature and provided findings from previous studies on ICT integration in education and pedagogy founded on the objectives. The study employed a descriptive survey design. The target population for the study comprised 99,128 respondents which included; 328 principals, 3,600 teachers and 95,200 students from the secondary schools in the 8 Sub-Counties of Machakos County. The study sampled; 180 principals, 360 teachers, and 398 students from the target population. The study embraced ratio proportionate sampling to get the sample size of the principals and teachers in each Sub-County. Random sampling and equal allocation methods were employed to choose the teachers and students in the sampled secondary schools. Data was collected by use of questionnaires, observation schedule, and document analysis guide. Content validity of the research instruments was ascertained through detailed comparative studies on the subject and piloting. To intensify the reliability of the instruments, test re-test, member check analysis, recording and re-recording methods were employed. Data analysis was done by use of the Statistical Package for Social Sciences (SPSS) programme where data was coded, fed into the computer, analyzed descriptively, and presented using frequency distribution tables. Responses from the observation schedule and document analysis guide were organized into themes and integrated with rest of the data for purposes of triangulation. Pearson's Product Moment was used to establish the level, the strength and the direction of the association amongst ICT integration and teachers' pedagogical practices. Pearson chi test was utilized to present and interpret the inferential data. Pearson chi test was employed to determine the levels of significance of the relationship between ICT integration and teachers' pedagogical practices. The study established that ICT trained teachers profoundly embraced the use of ICT skills to prepare e-based learning activities which enhanced their content preparation leading to more innovative lessons because of the acquisition of pedagogical ICT training. The study found that Non-ICT trained teachers lacked fundamental ICT skills to create technologically based instructional materials which limited their integration of ICT in content preparation. Further, the study revealed that ICT trained teachers used ICT to present PowerPoint, sound/audio clips, technology-based games, and draw diagrams which enriched their content delivery. The study also found out that Non-ICT trained teachers were not exposed to formal ICT pedagogical training, they applied their general ICT knowledge hence inhibiting their technology utilization thus lowering the quality of content delivery. The study further established that both ICT and Non-ICT trained teacher's utilized ICT to prepare continuous assessment tests (CATs), set examinations, thus increased frequency of assessment, timely and authentic feedback which enhanced their pedagogical practices. The study found that all the schools

lacked the ICT equipment for detecting plagiarism in students' essays. The study established that ICT trained teachers' utilized ICT skills more in teacher-learner interaction, which enhanced posting of revision questions, and lesson notes to students, online individualized interactions, and online question and answer interactions. The study also revealed that both ICT and Non-ICT trained teachers' use of ICT in teacher-learner interaction did not enable skyping amongst teachers and students. Dependent on the findings, the study concluded that ICT integration impacted on the combined teachers' pedagogical practices (content preparation, content delivery, content assessment, and teacher-learner interaction) among ICT trained teachers more than Non-ICT trained teachers in secondary schools. Hence the null hypothesis was rejected. Based on the findings and conclusions the study recommended that, the Ministry of Education (MOE) should intensify ICT training in teacher training institutions. The Teachers Service Commission (TSC) should ensure that pedagogical ICT training and certification are a requirement for all teachers who join the teaching profession for integration of ICT in pedagogy. Further research should be done on the initiatives by the Kenya Institute of Curriculum Development (KICD) towards the development of e-learning curriculums for secondary schools in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

In the recent three decades, progressive education systems have prioritized the utilization of Information Communication Technology (ICT) as a salient action that has had the capability to change teachers' pedagogical operations (Kozma & Vota, 2014). This has been based on several researches that have identified ICT as a pivotal feature of educational innovation and change (Mbodila & Kikunga, 2012). According to Ifenthaler and Schweinbenz, (2013) many countries, particularly in the developed world, have reported tangible improvements on teaching and learning following the amalgamation of ICT in teachers' pedagogical procedures. In addition, developed and developing countries have attested to the fact that ICT is an aqueduct for learning and must be a constituent of teachers' pedagogical exercises to improve the standard of teaching and learning.

In Africa, several countries such as Zimbabwe, Republic of South Africa, Morocco, Ghana, and Kenya, among others, have prioritized the adoption of ICT by teachers, despite financial and other logistical constraints, (Kayisire & Wei, 2016). Though conventional pedagogy has shown greater educational improvements over time, the incorporation of ICT in teachers' pedagogical practices is believed to exhibit more significant achievements in education worldwide. According to Robinson and Latchem, (2013) education policymakers have acknowledged that for citizens to overcome the 21st Century demands they must be in and should be in a place to communicate, ingress information, and use emerging technologies, hence ICT must be an integral part of educational pedagogy.

ICT amalgamation in education necessitates the incorporation of Information Communication Technologies (ICTs) in pedagogy to back and intensify the obtaining of suitable capabilities within learners, which comprise; skills, knowledge, attitudes, and values to manage learning efficiently (Bett, 2016). According to Alazam, (2013) ICT refers to technological tools and resources used in creating, sharing, and storing information. They consist of computers, computer networks, computer applications, digital content, PowerPoint, Liquid Crystal Display (LCD) projectors, digital cameras, video cameras, smart phones, whiteboards, smart boards, Digital Video Display (DVD) and Compact Disc (CD) players. Pedagogy, broadly defined, entails the didactic approach and strategies which permit learning to occur (Amuko, 2015). Fernandez-Ferrer and Cano (2016) defined teachers' pedagogical practices as the, teachers' actions and discourses that allude the cooperation amid the teacher and the learners. These include, among others, content preparation, methods of content delivery, content assessment, and teacher-learner interaction.

Practicably to make use of technology in pedagogy effective, educators should be trained on the utilization and application of modern technologies in their respective fields of education to implement the recommended and proposed changes concerning ICT in education (Bertram & Waldrip, 2013). The study intended to probe how the integration of ICT had impacted on the pedagogical norms of ICT and Non-ICT trained teachers in Kenyan secondary schools.

An efficacious application of ICT in pedagogy improves teachers content preparation, teacher-learner interaction, upgrades their methods of content assessment, and delivery, as well as facilitating learners' ingress to knowledge and developing within them higher form thinking abilities, accessing variant information from the internet,

increased students' problem-solving skills, participation in the learning process, and collaboration with other students (Heick, 2016). The World Education Forum held in Dakar, Senegal, in April 2002, recommended the utilization of ICT in teaching and learning to better the value of education and assure the attainment of accepted and measurable learning results. In their quest to attain the Sustainable Development Goals (SDGs), both developed and developing nations globally commenced on educational reforms geared towards at embedding ICT in educational practice (UNESCO, 2015).

Teachers play a cardinal role in education; hence they require specialized ICT training to acquire knowledge and competencies for appropriate incorporation of technology in their teaching and learning practices. Passi (2014) posited that, many teacher training institutions across the world had undergone structural changes in their training content due to rapid technological development to ensure that they produce teachers who can apply technology in the classroom. These initiatives resulted to the production of ICT trained teachers competent to integrate ICT in their instructions. Villamor (2011) argued that countries whose teacher training models lack structured ICT components graduate Non-ICT trained teachers' deficient of the technological competence to integrate ICT in pedagogy.

Countries that have fully trained their teachers on ICT and exploited the prospective application of technology in education and pedagogy, mostly in the global north, have attained significant knowledge development (Tabira & Otieno, 2017). Ishizuka (2013) found out that in the United States the International Society for Technology in Education (ISTE) provided guidelines and standards for ICT training of teachers to ensure effective combination of ICT in the learning environment at all extends. These

ICT trained teachers used and applied technology in all features of learning and teaching leading to the production of globally competitive learners.

According to Kampylis and Punie, (2013) teachers need adequate intuition into the pedagogical function of ICT to utilize it significantly in their instructional undertakings; they require sufficient knowledge to implement the technological role in education. Notably ICT trained teachers in Canada were reported to be efficient in the application of ICT tools in their classroom activities as opposed to Non-ICT trained teachers who avoided merging technology in their instruction and learning due to inability to select appropriate ICT tools and develop content based on their subject matter (Kampylis & Punie, 2013).

Studies done by Ateş, Çerçi and Derman, (2015) in Turkey indicated that though teachers were offered in-service and pre-service ICT instruction; the in-service courses based more on obtaining of basic ICT skills than utilization in teaching and learning. Therefore, the Non-ICT trained teachers in Turkish schools lacked adequate pedagogic training on technology use in pedagogy; they were dearth of generative knowledge to exert ICT in their content preparation, content delivery, and content assessment which limited their interaction. On the contrary, the ICT trained teachers who had acquired pre-service ICT training on technology application in pedagogy exhibited improved teacher-learner interaction, content preparation, upgraded content assessment techniques, and enriched methods of subject content delivery (Nkwenti, 2015).

According to Vuorikari, Garoia and Warwick, (2011) in Netherlands, teacher ICT training programs were conducted in a constructivist manner to ensure that teachers

gained confidence on the utilization of ICT tools in their pedagogical practices. ICT incorporation in innovative pedagogy by ICT trained teachers resulted in the escalation of digital learning environments. This made a commensurate impact on the methods of content preparation, content delivery, content assessment, and the interaction of teachers and students (Rampersad, 2011). In Norway, the state has clinched ICT utilization in pedagogy and recognized digital literacy as a primary skill for all teachers. This has resulted to adequate content preparation, ease in content delivery, improved teacher-learner interactions, and easy dissemination of assignments by ICT trained teachers, making the schools quite fruitful (Kozma & Vota, 2014).

According to Buabeng-Andoh, (2012) the United Kingdom, has embarked on an 'e-strategy' geared towards utilizing technology to alter pedagogy; majority of the educators were digitally literate but couldn't combine ICT in their classrooms because of absence of pedagogy-based technology use. The Non-ICT trained teachers were unable to select appropriate ICT tools and prepare digital content which hindered their content preparation, assessment and coverage, access to a greater variation of information, collaboration and networking with other instructors. The teachers who were exposed to technological pedagogy recorded reputable teacher-learner interaction, access to new and variant educational resources, broader content inclusion, and distinct understanding of complex ideas (Spektor-Levy & Granot-Gilat, 2012).

Holmes, (2013) observed that the dynamic nature of education and inclusion of innovative technologies had changed the teaching profession and placed demand on educators to familiarize themselves with ICT to join the global teacher community

and improve their pedagogy. The Japanese government has laid strategies to expose teachers to in-service training to furnish them with appropriate ICT expertise for efficient incorporation of technology in their pedagogical practices and for learners to adapt to the ever-evolving world (Niramitranon, Sharples Greenhalgh & Lin, 2010). Further studies by Vieluf, Kaplan and Bayer, (2013) found that teachers who were knowledgeable on ICT usage in pedagogy conducted meaningful lessons and exhibited expansive teaching potential compared to Non-ICT trained teachers who lacked sufficient expertise to incorporate ICT in their pedagogical practices.

A study conducted by Alazam, (2013) on ICT and Non-ICT trained teachers in Malaysia indicated that ICT trained teachers utilization of ICT in their pedagogy increased class collaboration, teacher-learner interaction, teachers creativity, enabled access to new and variant information, and simplified content delivery; compared to Non-ICT trained teachers in some regions who were reported to minimally utilize technology in their classroom activities resulting to low levels of learner motivation, teacher-learner interaction, content coverage and assessment hence lowering the quality of educational achievement and attainment by the learners (Alazam, 2014).

According to Wu, (2014) China teachers were offered multiple ICT training which addressed technology and its inclusion in pedagogy; they were equipped with both pre-service and in-service ICT training to challenge their pedagogical positions, attitudes, and perceptions towards ICT utilization in their teaching and learning. Pruet, Ang and Farzin, (2014) found that the ICT trained teachers reported improvements in their lesson presentations, content preparation, intensified methods of learner assessment, interactive classes, hence higher levels of educational attainments; whilst the Non-ICT trained teachers experienced challenges in choice of appropriate ICT

tools and preparation of ICT based educational materials which led to less interactive classes, low frequency of learner assessment thus low leaner participation in the teaching and learning practices.

Most African countries have embarked on educational reforms aimed at ICT integration in pedagogy and have drafted and approved ICT policies in education; in addition, they have established pre-service and in-service ICT training modules to ensure that educators gain knowhow on ICT based pedagogy (Greaves, 2012). Developing countries have adopted cost effective ICT training strategies, in a venture to overhaul their curricula through integration of ICT in pedagogy for critical educational outcomes and preparation of globally competitive learners (Khan, Hasan & Clement, 2012).

For example, in Ghana ICT initiatives, aimed at improving educational achievements by reforming secondary education through integration of ICT in teachers' pedagogical practices. The education department endeavored to assimilate technology in pre-service and in-service teacher training for full employment of ICT in teaching and enhance learning; this initial training promoted digital literacy more than the construction of technology based instructional materials (Greaves, 2012). As a result, the Non-ICT trained teachers were unable to select relevant ICT tools, access, and appraise educational materials from variant sources for content preparation, cover wider subject content, deliver content easily thus lowering the quality of teaching and learning. Comparatively, the ICT trained teachers who had exposure to either pre-service or in-service ICT training demonstrated command on the adoption and integration of ICT in their teaching operations; consequently, this resulted to increased students' problem-solving skills, higher frequency of content assessment,

access to expansive content and educational ideas, improved teacher-learner interactions, creativity and motivation amongst learners (Liu, 2011).

According to Heick, (2016) in Zimbabwe, secondary school teacher education institutions have incorporated ICT in their curricula to prepare ICT trained teachers conversant with ICT and e-learning. This has intensified content preparation by teachers, upgraded students understanding, thinking skills and motivation, improved content delivery, elevated content assessment, and teacher-learner interaction, heightening the quality of education. Findings from research done by Khan, Hasan and Clement, (2012) in Morocco showed that despite the endeavor by policy makers and Ministry of Education trainers on incorporation of ICT in pedagogy; some teachers were incompetent in the application of ICT in their classroom activities due to inadequate technological ingenuity. The ICT trained teachers assimilated technology in their pedagogical practices which stimulated the students through creation of conducive learning atmosphere, raised interaction and collaboration levels within learners and teachers, magnified content coverage, assessment and preparation techniques; thus, remodeling the quality of education. On the other hand, Non-ICT trained teachers lacked expertise on technology use in their subject areas which embedded their efforts to employ ICT in their pedagogical processes; thus, limited access to educational materials and resources, and low learner assessment rates (Khan, Hasan & Clement, 2012).

Correspondingly, research by Ahmadi, Keshavarzi and Foroutan, (2011) observed that in South Africa, insufficient digital literacy, lack of didactic and pedagogic training on ICT utilization in specific subject areas barred teachers from effective implementation of ICT in their classroom undertakings. The ministry of education resolved to institute

in-service ICT training in an attempt to transform teaching methodologies through technology. Further findings established that Non-ICT trained teachers in South African schools lowly applied technology in their pedagogical operations which negatively imparted on their content preparation, content assessment, content coverage, and interaction with learners affecting students' creativity, motivation, and participation in learning (Wallet & Beatriz, 2015). However, teachers who had undergone ICT pedagogical training displayed knowhow in the incorporation of technology in their teaching and learning progression; enriching their methods of content delivery, upgrading content assessment, magnifying students' participation in learning, elevating their collaboration, and interaction with their students (Wallet & Beatriz, 2015).

Hennesy, David and Wamakote (2010) found out that East African countries, Tanzania, Uganda, among others had made the teaching profession a centre of focus due to technological advancements, expansion of knowledge, coupled with globalization. Buabeng (2012) asserted that despite lack of structured pre-service ICT training, efforts had been made to expose teachers to in-service pedagogical ICT training to promote the incorporation of technology in their classroom operations. This implied that majority of educators in the East African region were dearth of ICT proficiency for full usage of ICT in their pedagogical practices.

Consequently, the Non-ICT trained teachers lagged behind in technological integration in their pedagogy, resulting to less interactive and innovative teaching atmosphere, limited learner assessment, inability to access variant information from the internet, and exchange educational ideas and materials with other educators; compared to the ICT trained teachers who attempted to integrate ICT in their

pedagogical practices notwithstanding inaccessibility and unavailability of ICT tools in the institutions, and insufficient in-service training resulting to improved content preparation and presentation, intensive students' participation in learning, and significant improvement in students' performance (Nyambane & Nzuki, 2014).

In Kenya, the use of ICT is fore grounded as a key driver of the country's vision 2030. The education sub-sector, in the vision 2030 social tower, aims at providing internationally competitive and standard education and research for tenable progress (MOE, 2012). This aim shall be fulfilled amid others, enacting Kenya's National ICT Policy (MOICT, 2016). The policy strives at streamlining ICT integration in the teaching curriculum, setting up e-education collaborations, and advancing e-learning at all categories of learning. It additionally targets at accelerating the starting of national ICT centres of excellence to reveal amalgamation of ICT in teaching and learning, and train teachers on ICT pedagogical capacity. It aims at equipping the national educational system with ICT knowledge and competencies linked to inventiveness needed to steer Kenya's vision 2030 economic and social aims (MOE, 2012).

Ultimately, whilst the benefits of ICT fusion in education might be clearly documented, effective utilization and application of ICT in pedagogy is highly contingent on the teachers' level of instruction on the pedagogical aspects of ICT integration in the teaching and learning procedure. Teachers' ICT skills ascertain their adoption and use of technologies in their pedagogical practices which in turn influences their content preparation, content delivery, content assessment, and interaction with learners (Peeraer & Petegem, 2012).

In response to the fore discussed, the government of Kenya through the Ministry of Education (MOE) has begun initiatives for supporting and promoting ICT incorporation in education and utilization in pedagogy. The initiatives are centered on improvement of the standard of education through provision of ICT literacy and its integration in pedagogy (MOE, 2013). Teacher training institutions have included ICT education in their pre-service instruction curriculum with more emphasis on teaching with technology rather than teaching about technology, to produce ICT trained teachers. Further, the Education Ministry in partnership with other ICT development partners have organized in-service training programmes to enable Non-ICT trained teachers incorporate ICT in their pedagogy. The Kenya Institute of Curriculum Development (KICD) have developed e-learning resources that ICT is comprehensively combined in teaching and learning and enable students participate in the learning process (Kombo, 2013).

Despite the MOE commitment to ICT integration in pedagogy and the general endorsement of ICT in pedagogy by teachers in Kenyan secondary schools; Kenya being a developing nation is struggling towards the realization of full ICT integration in education and teachers' pedagogical practices in particular. The initiative has been hindered by insufficient ICT infrastructural facilities, the centre of ICT as a subject other than a pedagogical tool, coupled up with inadequate ICT training of teachers. The MOE has not been able to offer sufficient ICT training to all secondary schools teachers, thus, the presence of ICT and Non-ICT trained Kenyan secondary schools teachers. This signifies that the integration and application of ICT in the teaching and learning process in the education sector in Kenya, and particularly in secondary schools is still in its infancy.

Similarly, in Machakos County, the MOE in collaboration with education trainers has organized ICT training programmes to enable the practicing teachers gain knowledge and skills on the implementation of technology in their teaching and learning activities. Notwithstanding, many schools and teachers in Machakos County have not been exposed to such training, which limits the fusion of ICT in their pedagogical practices. This eventually justifies the presence of ICT and Non-ICT trained teachers in secondary schools in Machakos County. To appropriately merge ICT in pedagogy and improve the quality of education, teacher's ICT literacy and ICT pedagogical training must be done concurrently.

However, in Africa generally, and in Kenya specifically, there has been limited study on accessing how the integration of ICT has impacted on teachers' pedagogical practices. The study sought to address this gap by examining how ICT integration influences the pedagogical processes of teachers in Kenyan public secondary schools. It was noteworthy to analyze how the merger of ICT in teachers' pedagogical enactment influenced their content preparation, content delivery, content assessment, and teacher-learner interaction. This study, therefore, purposed to carry out a comparative study involving the ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya to evaluate the influence of ICT amalgamation in their pedagogical practices.

1.2 Statement of the problem

Arising from the aforesaid background to the study, it is clear that the utilization and integration of ICTs in pedagogy catalyzes and transforms teachers' pedagogical practices and ensures productive teaching and learning. This can be attained through professionally developing teachers who can providentially integrate technology in

their pedagogical practices. In Kenya, the Ministry of Education has prioritized ICT incorporation in teaching through the inclusion of ICT education in teacher training institutions for the incorporation of ICTs in secondary school's pedagogics. In addition, the MOE has partnered with other development agencies in an endeavor to provide ICT in-service training to secondary school teachers to facilitate the incorporation of ICT in their didactics. For instance, they have established ICT centres of excellence in Machakos County to ensure that secondary school teachers acquire ICT skills for technology application in pedagogy.

However, the initiatives have faced challenges such as; inadequate ICT training which has prioritized provision of technological literacy than ICT based pedagogy to enable teachers entirely integrate ICT in their instructions, inadequate ICT facilities, and the target of ICT as a subject rather than a tool for curriculum strengthening. This has led to low pace of ICT unification by teachers in Kenyan classrooms which has inhibited the provision of quality education.

Despite the immense efforts and resources directed towards the merger of ICT in education and pedagogy globally and moreover so in Kenya the highlighted setbacks have negatively imparted in the integration of ICT in teachers' pedagogical practices in secondary schools. Consequently, considering the efforts made by MOE in introducing, advocating, and enacting this initiative in Kenya secondary schools, contemporary assessment reports by Machakos County Education Quality Assurance and Standards Office (CQASO) showed that ICT application by teachers in pedagogy was barely at its neophyte stage and teachers showed considerable variations in their union of ICT in pedagogy within the County. The technological uptake by teachers and inadequate ICT training had created a lag between teachers' pedagogical behavior

change and its actual integration in pedagogy which was probably to affect the standard of education. Hence, the existence of ICT and Non-ICT trained teachers in Machakos County and variant ICT application in pedagogy which escalated the need for this study.

In this regard, this study, sought to explore the impact of ICT amalgamation in teachers' pedagogical exercises of ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. For the purposes of this study the variables to be investigated included; content preparation, content delivery, content assessment, and teacher-learner interaction. The study sought to interrogate how ICT integration has imparted on teachers' pedagogical practices.

1.3 Purpose of the study

The aim of this study was to investigate the impact of ICT integration in pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

1.4 Objectives of the study

The study was guided by the following objectives:

i) To determine the impact of ICT integration on content preparation by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

ii) To establish the impact of ICT integration on content delivery by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

iii) To determine the impact of ICT integration on content assessment by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

iv) To establish the impact of ICT integration on teacher-learner interaction of ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

1.5 Research Hypothesis

The study sought to test the following null hypothesis:

i) **H_1** ICT integration does not significantly impact on content preparation by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

ii) **H_2** ICT integration does not significantly impact on content delivery by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

iii) **H_3** ICT integration does not significantly impact on content assessment by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

iv) **H_4** ICT integration does not significantly impact on teacher-learner interaction of ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

v) **H_5** ICT integration does not significantly impact on the combined pedagogical practices on content preparation, content delivery, content assessment, and teacher-learner interaction by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

1.6 Significance of the study

The findings of this study might serve a beneficial function in accelerating sharing of information and expertise in the quest to entrench pedagogical ICT programs in teacher training institutions. Such information would assist policy decision makers and education curriculum stakeholders in identifying the operators and hurdles to ICT integration in teacher training and in the education system, including those aspects associated with curriculum and pedagogy, infrastructure, capacity development, language and content, and funding.

The research findings would provide vital information to the Teachers Service Commission (TSC) to formulate professional guidelines which emphasize on pedagogical ICT certification as prerequisite for professionalism and employment. The findings of the study may prompt secondary school administrators to realize the prominence of formulating school ICT tactics with coherent aims and ways of achieving them for full integration of ICT in pedagogy. In addition, the study findings may lead to creation of more knowledge to the teachers and students and realization of the effectuality of ICT based pedagogy on the educational process.

The study findings can constitute a baseline reflector to the MOE and relevant sections including funders to evaluate their performance towards the provision of pedagogical ICT training and its impact on the quality of education. The findings could also provide to the expanding pool of research literature on ICT fusion in pedagogy in Africa, and the general developing nations. Lastly, the findings, that shall be additionally disseminated by journal publications and scholarly conferences, shall probably evoke discussions in scholarly sphere that shall result in extended research in this discipline.

1.7 Limitations of the study

On the process of conducting the research some respondents were hesitant to cooperate due to bureaucratic issues. To overcome this limitation the researcher sought a letter seeking permission to undertake the research from the Machakos County Director of Education, presented it to them and assured them that the study findings were to be used for the research purpose only. Concealing of some important information and failure to avail all the documents required was an obstacle during the study.

The researcher assured them of confidentiality, and explained to them the importance of the study and their contributions. Pulling off of some respondents and the feeling that the exercise consumed much of their teaching hours was a challenge participation of the respondents and assured them that the research would not affect their teaching schedule.

1.8 Delimitations of the study

The study focused on ICT and Non-ICT trained teachers in secondary schools in Machakos County. In regard to ICT training, the study focused on the teachers who had been trained on ICT since 2010. Considering that there are various pedagogical exercises concerning the use of ICT, this study addressed the impact of ICT merger as pertains to content preparation, content delivery, content assessment, and teacher-learner interaction.

1.9 Assumptions of the study

The study was based on the following assumptions;

i) The teachers in Machakos County secondary schools were incorporating ICT in their content preparation.

ii) Secondary school teachers in Machakos County were incorporating ICT in their content delivery.

iii) The secondary school teachers in Machakos County were incorporating ICT in their content assessment.

iv) Secondary school teachers in Machakos County were incorporating ICT in teacher-learner interaction.

v) There were teachers who had acquired formal pre-service and in-service ICT instruction in secondary schools in Machakos County.

vi) There were teachers who had not acquired formal pre-service and in-service ICT training in secondary schools in Machakos County.

vii) There were variations in the utilization of ICT in pedagogical practices of teachers in secondary schools of Machakos County.

1.10 Definition of operational terms

Content assessment alludes to the techniques used in determining the progress of students learning. This includes internal examinations, class assignments, presentations, continuous assessment test (CAT) and essays by teachers whether ICT or Non-ICT trained in secondary schools.

Content delivery refers to the use of power point, simulations, imagery, video and audio clips, graphics, animations, role play, and technology-based games in the delivery of content by teachers, whether ICT or Non-ICT trained in secondary schools.

Content preparation alludes to the utilization of ICT in preparation of projects of work, lesson plans, lesson notes, records of work, research lesson content, access materials, prepare presentations, and lesson attendance sheets by teachers, whether ICT or Non-ICT trained in secondary schools.

ICT development partners refers to the organizations which have partnered with the MOE to provide ICT training and support ICT integration in pedagogy by teachers, whether ICT or Non-ICT trained in secondary schools.

ICT equipment refers to all technological devices used for learning and teaching procedures in secondary schools. These may include computer software, smart phones, internet, digital cameras, video cameras, LCD projectors, radios/TVs, laptops, tablets, whiteboards, and smart boards.

ICT integration refers to the incorporation of Information Communication Technologies (ICTs) in education and more specifically in teachers' pedagogical practices to improve the educational development and achievements whether ICT or Non-ICT trained in secondary schools.

ICT trained teachers refers to teachers who had acquired pre-service and in-service ICT training in secondary schools.

Information Communication Technology (ICT) alludes to all technologies that are used for the formation, storage, display, and communication of information such as computers, computer networks, computer applications, digital content, DVD and CD players.

Non-ICT trained teachers refers to the teachers who had not undergone formal pre-service or in-service ICT training, however, they apply ICT in their secondary schools teaching.

Teacher-learner interaction refers to the ICT related class activities which define the contact between the teacher and students. These may include online group discussion, one on one interaction, video conferencing, chatting, question and answer forums, posting lesson notes, assignments and revision questions to students either generated by teachers or students.

Teachers' pedagogical practices refer to the procedures and activities applied in teaching didactic. These include content preparation, teachers' methods of content delivery, content assessment, and teacher-learner interaction by teachers, whether ICT and Non-ICT trained in secondary schools.

1.11 Organization of the study

The study was arranged as follows: Chapter one dealt with the background to the study, statement of the problem, purpose of the study, objectives of the study,

research hypothesis, significance of the study, limitations of the study, delimitations of the study, definition of operational terms, and organization of the study. Chapter two focused on review of related literature, conceptual frame work, and theoretical framework. Chapter three covered the research methodology used in this study. Chapter four dealt with data analysis, interpretation and presentation, and finally chapter five presented the summary, conclusions and recommendations of the study findings, and suggestions for further study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

The literature review targeted ICT incorporation in education and specifically on teachers' pedagogical practices. This chapter focused on the impact of ICT integration on teachers' pedagogical procedures that included content preparation, content delivery, content assessment, and teacher-learner interaction by teachers whether ICT or Non-ICT trained in secondary schools. The chapter also captured the synopsis of the reviewed literature and the conceptual framework.

2.2 ICT integration in education pedagogy

In order to understand the denotation of ICT incorporation in pedagogy, Amuko (2015) defined ICT for educational pedagogy as the growth of ICTs particularly for teaching and learning motives; whilst ICT in educational pedagogy as the acceptance of ICT tools in the teaching and learning process. According to Nkwenti (2015) the combination of technologies in education and teachers' pedagogical practices modified teaching leading to greater educational attainments globally; This key function that ICT incorporation in education performs in altering teachers' pedagogy was further stressed by The International Conference on Teaching and Learning with Technology [ICTLT], (2010).

Roblyer and Doering (2013) posited that efficient learning is not influenced by the availability of ICTs but rather their use in teachers' pedagogical practices, hence the need to merge subject e-content and pedagogy for full fusion of ICT learning and teaching. Further this heightens the methods of content preparation, content delivery, content assessment, and the interaction of teachers and learners. A study conducted by Bocconi, Kampylis and Punie, (2013) on ICT incorporation in teachers' pedagogy in

Europe divulged that ICT have the possibility to expedite, intensify and enhance teaching skills as well as engaging, motivating, and enhancing students' performance. Ghani and Tengyue (2014) found out that ICT use in pedagogy by ICT trained teachers in Malaysia provided an essential instrument that supported creative means of teaching to teachers, upgraded their content preparation, and methods of delivery; to the students, ICT use enhanced communication skills, collaboration among students, problem solving, creativity, and led to interactive learning hence quality education.

Khan, Hasan and Clement (2012) observed that technology-based pedagogy by ICT trained teachers in Morocco resulted to intensified assessment procedures, extensive teaching resources, and aggrandized delivery techniques which improved the quality of education. On the contrary the Non-ICT trained teachers limitedly applied ICT in their pedagogy due to negative attitude and lack of adequate training; resulting to less interactive classes, moderate frequency of content assessment, and less innovative techniques of content delivery which imparted on the educational process (Khan, Hasan & Clement, 2012).

A comparative study on e-readiness in Sub-Saharan Africa by Wallet and Beatriz, (2015) indicated that ICT trained teachers' integration of ICT in their pedagogics influenced their subject content preparation, methods of learner examination, and enabled teachers to present video and audio clips, animations, and graphics elevating classroom interactions and creative learning. On the contrary the Non-ICT trained teachers lacked the expertise to prepare technology-based lessons, simulations, and video clips to boost students understanding which limited student's participation in the learning process (Wallet & Beatriz, 2015).

Lim, Chai and Churchill (2011) posited that many East African countries, Kenya included had invested in ICT integration in educational pedagogy and creation of technology-based teaching and learning environments in secondary schools. However, Nyambane and Nzuki (2014) found that East African countries had not comprehensively embraced ICT based pedagogy due to insufficient ICT training in teacher education programs. Notwithstanding, the ICT trained teachers who positively integrated ICT in their pedagogy reported improvements on their levels of learner assessment, advanced modes of passing on variant information to the learners, and enriched methods of content preparation hence increased teacher creativity, innovation, and interaction with the learners. Further Pruet, Ang and Farzin, (2014) found that Non-ICT trained teachers minimally utilized technology in their pedagogical practices resulting to decreased frequency of content assessment, inadequate class demonstrations, less interactive lessons and learner participation, poor communication, and collaboration amongst students which affected the students' performance.

The government of Kenya having noticed the catalytic function of ICT incorporation in pedagogy and consequently its implications on the quality of education, has attempted to introduce ICT education and training programs in teacher education institutions for the production of ICT proficient teachers (Tabira & Otieno, 2017). In addition, it has preferred ICT use for enriching standard teaching in secondary education and attainment of teaching purposes through the provision of in-service ICT training. The broad objective is to possess ICTs embraced for teaching and learning in primary and secondary schools across the entire nation as part of the country's

commitment to attain standard education and instruction for Vision 2030 (MOE, 2013).

In this regard, the Kenya Institute of Curriculum Development (KICD) is tasked to review the curriculum in line with the pedagogical systems with the expeditious technological conversions to harbor the learners' requirements. On their part, individual secondary schools have devised ICT policies with coherent purposes and ways of recognizing them for ICT use in pedagogy (MOE, 2013).

According to Kombo (2013) ICT amalgamation in pedagogy in Kenyan secondary education is complicated because of the mixture of Kenya's economic, social-cultural, and physical environment. Firstly, 32 percent of the children attend schools with obstacles varying from absence of electricity, insufficient ICT infrastructure and internet connectivity. Secondly, the Kenyan secondary school curriculum is broad, thus teachers have insufficient time for preparing for digital classes, sort educational software, traverse internet sites and address technical challenges coupled with insufficient pre-service and in-service ICT training (Amuko, 2015).

While ICT combination in teachers' pedagogics holds on proceeding in Europe, Asia, and other countries, the teachers' level of ICT training inhibits their adoption and use in secondary schools in Kenya. Despite the MOEs efforts to provide pre-service and in-service pedagogical ICT training, challenges related to inadequacy of finance, insufficient ICT infrastructure, resistance to change, among others have obstructed the progress. This is an implication that all Kenyan secondary schools' teachers have not acquired the relevant ICT pedagogical skills. This justifies the presence of ICT and Non-ICT trained teachers in secondary schools in Kenya which generates the need for this study.

2.3 The impact of ICT integration on content preparation in secondary schools

Having reviewed related literature on ICT integration in education pedagogy by teachers globally, this section reviewed related literature focusing on ICT integration and content preparation. Successful union of ICT in teachers' pedagogical exercises impacts on the methods of content preparation by educators. According to Badri (2014) the application of ICT in pedagogy by ICT and Non-ICT trained teachers enhanced their ability to prepare programs of work, lesson plans, lesson notes, lesson attendance sheets, records of work, and access to variant information for quality resources and innovative teaching and learning.

Comprehensive integration of ICT in pedagogy transforms lesson planning and preparedness of teachers. Lee and Tsai (2010) opined that ICT and Non-ICT trained teachers used word processor to prepare lesson plans, schedules of work, records of work, and compile class materials; moreover, they searched different sites for educational resources leading to quality course content and heightened pedagogical practices. A comparative study conducted by Sigales (2013) in 22 secondary schools in Singapore concluded that ICT trained teachers' application of technology in content preparation enabled the creation of multimedia based interactive and experimental instructional materials which catered for students with different learning abilities, enhanced access to a wide range of educational materials from online sources thus inclusive and quality education.

According to Tezci (2011) Non-ICT trained teachers were not sufficiently equipped with the skills to develop learning management software's which hindered the integration of technology in their content preparation. He further argued that high school teachers in Abu Dhabi region of United Arab reported lack of fundamental

ICT skills as an impediment affecting their ability to use computer peripheral devices to prepare e-based learner-content interactive activities like PowerPoint presentations, audio/sound clips, video clips, images, and students' worksheets (Tezci, 2011).

Besides, integration of ICT in lesson preparation by ICT proficient teachers made learning more relevant to real life experiences, enabled teachers to develop higher and lower thinking skills through inclusion of images, video and audio clips, PowerPoint presentations hence clarity of difficult concepts and increased problem-solving skills (Erdogan, 2011). Research done in Italy among 80 secondary school teachers revealed that ICT trained teachers applied technology in lesson preparation which enabled them to easily access variant educational resources and resource formats including; audio clips, texts, images, and video/sound clips which made their subject content simpler and more innovative (Badri, 2014).

A study by Magbagbeola (2012) in Nigeria reported that ICT trained teachers' utilization of technology in pedagogy simplified their preparation of professional documents, enabled them to extensively research subject content, prepare PowerPoint presentations, audio and video clips which made learning interesting and interactive thus improving students' academic performance, innovation, and creativity. On the other hand, Non-ICT trained teachers were deficient of ICT skills to plan technology lessons, sort educational software and explore internet sites for teaching materials, prepare PowerPoint slides, and images for class presentation which resulted to teacher centered classroom activities (Magbagbeola, 2012).

Heick (2016) found out that in Turkish schools both ICT and Non-ICT trained teachers were knowledgeable in basic ICT but the level of integration in lesson

preparation was very low due to huge workloads and insufficient time to use ICT tools. The teachers lowly employed ICT in preparing video clips and images to merge with the subject content, develop lesson attendance sheets, and records of work which negatively influenced their creativity, innovation, and students' academic achievements.

According to Teo, Fan and Du (2015) ICT provided teachers with digital tools and platforms designed to ease content preparation, engage learners, expose them to appropriate learning opportunities and variant information, and connect them to the real-world making them more efficient. Erdogan (2011) argued that ICT trained teachers created learning tasks which were authentic, experimental, personalized, learner designed and driven which enriched their mode of preparation, quality of education and learner engagement.

Khan, Hasan and Clement (2012) posited that Non-ICT trained teachers possessed inadequate or inappropriate ICT training to confidently execute ICT based pedagogy in preparing and searching teaching materials for their lessons, as well as matching images, video and audio/sound clips with their subject content. Consequently, the incorporation of ICT in pedagogy impacted on the modes of lesson preparation by the ICT trained teachers, enhanced their innovative skills, widened their pool of content, and increased their creativity thus improving the quality of education (Hennesy, David & Wamakote, 2010).

The fore reviewed literature showed that ICT integration in teachers' pedagogical practices impacted on their content preparation. It was on this backdrop that this study was conceived to establish the impact of ICT integration on content preparation by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

2.4 The impact of ICT integration on content delivery in secondary schools

Having reviewed related literature on content preparation by teachers, this section reviewed related literature focusing on content delivery. The integration of ICT in pedagogy heightens the modes of content delivery by ICT and Non-ICT trained teachers. Turel and Johnson (2012) found that in Europe ICT trained teachers used computers, laptops, and devices like; interactive whiteboards, LCD projectors, mobile devices, and peripheral devices in content delivery which enables demonstration thus impacting on their content coverage efficiency and students' performance.

Relatively, Ertmer and Ottenbreit-Leftwich (2010) alluded that the use of ICT in content delivery by ICT and Non-ICT trained teachers lead to comprehensive application of classroom technology-based games, role play and imagery resources hence more innovative, collaborative, and productive teaching boosting the learners' curiosity and creativity. On the contrary Ayub and Bakar (2012) found that both ICT and Non-ICT trained teachers were resistant to change their professional practices which hindered employment of new technologies in their content delivery; they held that ICT use in classroom activities derailed achievement of the lesson objectives due to the limited time scheduled for the lessons and overwhelmed curriculum; hence insufficient time to assemble the ICT tools.

Further, research by Capan (2012) found out that ICT trained teachers in Canada employed technology to support their delivery styles through use of variant digital formats like; PowerPoint slides, video and audio/sound clips, simulations, graphics, drawing diagrams, and technological games thus quality demonstrations appealing to the learners. Equivalently, a study conducted by Lewis (2012) in Saudi Arabia on ICT integration by ICT trained teachers in science education pointed out that, the use of

simulations, pictures, graphics, video and audio clips resulted to more demonstrative teaching, question and answer approach, authentic and enquiry based learning, and deeper understanding of abstract concepts.

Successful implementation of ICT in instruction by ICT trained teachers enhanced the application of dynamic and highly participative learning activities which created maximum opportunities for intensive questions, demonstration of technical concepts, exchange of ideas, and application of graphics to relate subject content with real life experiences (Turel & Johnson, 2012). Similarly, a study by Eickelmann (2011) on ICT trained secondary school teachers in Norway on the function of ICT in learning observed that the use of PowerPoint presentation slides and technologies made the lectures clear for the learners to understand, created a more learner-centered environment, triggered critical thinking, and resulted to wider content coverage.

According to Khan, Hasan and Clement (2012) Non-ICT trained secondary school teachers in Morocco didn't embrace technology supported pedagogy such as; multimedia applications, drawing diagrams, animating objects to clarify critical concepts, showing pictures, and playing videos hence less interesting and productive lessons lowering the quality of content delivery. Comparatively, the ICT trained teachers embraced technology to conduct ICT based games, present imageries, simulations, animations, graphics, and draw digital diagrams which led to efficient demonstration, and enriched methods of content delivery (Khan, Hasan & Clement, 2012).

Nkwenti (2015), argued that technology utilization by both ICT and Non-ICT trained teachers transformed and upgraded their classroom presentations resulting to extensive question and answer approach thus quality teaching and learning.

Correspondingly, Wallet and Beatriz (2015) affirmed that ICT trained teachers possessed relevant ICT training; conducted and integrated role play techniques, technology-based games in content delivery, and matched video and sound/audio clips with subject content; this heightened their delivery proficiency and quality of education compared to Non-ICT trained teachers who were deficient of formal ICT skills, lacked adequate and well-conditioned ICT equipment.

Passi (2014) argued that the application of technology in content delivery by ICT trained teachers led to demonstrative instructional strategy through the presentation of models, objects, diagrams, charts, slides, and pictures which enabled them to explain concrete concepts, facts, and problems to the learners thus quality teaching and learning. Similarly, ICT and Non-ICT trained teachers used the internet to upload recorded video demonstrations, sound clips, and images which upgraded their lectures; this enabled them to clarify and explain educational concepts and ideas through extensive use of description narratives thus improving students' participation and the quality of education (Pruet, Ang & Farzin, 2014).

According to Wallet and Beatriz (2015) technology usage in content delivery enabled ICT trained teachers create digital environments through the presentation of simulations, animations, and technology-based games which exposed the students to the real world, enabled them gain practical experience, boosting their creativity and engagement in learning. In addition, Capan (2012 posited that both ICT and Non-ICT trained teachers conducted role-playing techniques in classroom delivery and combined it with dramatization of educational ideas which made delivery more effective and relevant to the students' social situations boosting their understanding.

Despite the importance of ICT use in teachers' pedagogics, majority of teachers in developing countries were unable to merge ICT with their lesson content for efficient delivery. (Pruet, Ang & Farzin, 2014). Nkwenti (2015) argued that Non-ICT trained teachers lacked ICT competence to perform complex technology-based delivery techniques like presenting graphics, simulations, animations, and preparing PowerPoint presentations which made their teaching less innovative, non-creative and unfriendly to learners; compared to the ICT trained teachers who had the relevant skills and knowledge to utilize ICT in their content delivery resulting to learner centered pedagogy, clarity of complex concepts, quality lectures, and improved academic performance (Nkwenti, 2015).

This study therefore, sought to confirm or disaffirm these findings by examining the extent to which ICT integration impacted on content delivery by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

2.5 The influence of ICT integration on content assessment in secondary schools

The previous sections reviewed related literature on content preparation and content delivery by teachers. This section considered review of literature related to content assessment by teachers. According to Kayisire and Wei (2016) content assessment is a vital component of education systems; it plays a critical role in measuring the learners' mastery of skills and academic achievements. In addition, Conole (2013) asserted that assessment helped teachers to improve their methods of instruction, motivated students to learn, informed administrators on resource allocation, and enabled policy makers to evaluate the efficacy of educational programs.

The application of ICT in teachers' content assessment practices alleviated the levels, tools, and methods of evaluating and measuring students learning outcomes in the educational process (Chien, Wu & Hsu, 2014). Notably ICT trained teachers utilized digital devices to prepare examinations, class assignments, write Computer Studies examinations, compile students' performance reports, and provide online feedback on students' performance and grades thus improving their content assessment efficacy (Alazam, 2013). Howard (2013) asserted that both ICT and Non-ICT trained teachers used computer peripherals to formulate their assessment tasks, record and analyze students' responses, and provide examination performance feedback thus able to assess whether lesson objectives had been achieved and assess a wide range of skills which elevated students' motivation to learn.

According to Tsai and Chai (2012), ICT trained teachers applied their technology expertise to access a wider pool of examinations and experiments online thus upgrading their preparation of assignments, internal examinations, continuous assessment tests (CATs), class presentations, and essays administered to the learners; this increased their frequency of assessment, and enabled access to solutions for difficult and complex tasks. Non-ICT trained teachers were deficient of the required expertise to apply ICT in grading students' performance, providing online feedback on students' performance, compiling and tracking cumulative students' examination reports thus limiting their assessment intervals, and achievement of the outlined learner outcomes (Tsai & Chai, 2012).

According to Ishizuka (2013), ICT trained teachers in Spain used Computer Assisted Assessment (CAA) to conduct formative and summative assessment of students' performance and learning; these helped students to gauge their level of understanding

of the intended concepts, enabled the teachers to apply the appropriate instructional strategies, and facilitated provision of timely feedback. Studies conducted in Portugal and Australia indicated that lack of ICT skills by Non-ICT trained teachers made it difficult for them to design ICT based examinations, essays, assignments, provide feedback on students' performance, and track their performances which derailed their efforts to use technology in content assessment (Teo, Fan & Du, 2015).

Non-ICT trained teacher's exhibited lack of current ICT knowledge and skills relevant in pedagogy (Conole, 2013). A survey conducted by Magbagbeola (2012) in Osun state of Nigeria showed that Non-ICT trained teachers faced challenges in utilization of ICT to assess their learners' progress, majority were unable to calculate and compile performance reports using spreadsheets and track students results which limited their range and mode of content assessment. Comparatively the ICT trained teachers were found to employ ICT in assessing the learners' performance hence boosting the rate and interval of examination; rather the teachers were unable to detect plagiarism in essays and track students' performance due to unavailability of some digital programs and devices (Magbagbeola, 2012).

A study conducted by Bocconi, Kampylis and Punie (2013) in Europe on the influence of ICT integration on content assessment revealed that ICT trained teachers used Learning Management Systems (LMS) to report on the learner-content interaction, register and track learners progress, record test scores, and show course completions. Farrell and Rushby (2016) argued that technology use in assessment by ICT and Non-ICT trained teachers facilitated the application of variant Classroom Assessment Techniques (CATs) easy to use and interpret, thus enabling provision of

short-term feedback and wealth information about students' thinking, enriching the efficacy of examination, and improving students' performance.

In Saudi Arabia a study on ICT and learners' assessment observed that ICT trained high school teachers reported higher satisfaction regarding fast dissemination of assignments, examination of wide content, efficiency in testing factual knowledge, easy marking and correcting of tests, increased students' confidence, and ultimate students' performance (Ifenthaler & Schweinbenz, 2013). Further, the Non-ICT trained teachers lacked the technological skills to track cumulative students' performance, grade students using technology, and detect plagiarism in students' essays thus influencing their quality and frequency of assessment (Ifenthaler & Schweinbenz, 2013).

Farrell and Rushby (2016) postulated that assessment is an integral part of the teaching and learning process; the application of ICT in content assessment by ICT and Non-ICT trained teachers impacted on their preparation of class assignments, CATs, examinations, and writing of Computer Studies examinations leading to the achievement of the desired Student Learning Outcomes (SLOs). This study examined the contention of this scholarly works and desired to establish whether ICT integration had an impact on content assessment by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

2.6 The impact of ICT integration on teacher-learner interaction in secondary schools

Having reviewed related literature on content preparation, content delivery, and content assessment by teachers in the previous sections, this section reviewed related literature centered on teacher-learner interaction. Conole, (2013) stated that teacher-

learner interaction entailed the methods which enhanced the relationship between the instructor and the students; online group discussions, posting of notes, assignments and revision questions to students, video conferencing, and one on one communication approach.

Ayub and Bakar, (2012) asserted that ICT integration in pedagogy facilitated teacher-learner interaction leading to effective construction of knowledge, collaborative teaching and learning, in-depth conversations, provision of a wide range of answers to complex tasks, and increased student motivation. According to Bertram and Waldrip (2013), ICT trained teachers used Personal Digital Entertainment Devices (PDEDs) to download, store and play photos, audio and video files which led to interactive learning, one on one classroom communication and rapport, informed group discussions and debates, critical thinking, and improved students' competence.

The usage of ICT tools by ICT trained teachers stimulated student's involvement in online classroom discussions, online individualized interaction, motivated and enabled students to internalize the content taught, promoted teacher-learner one on one communication hence building consensus, and improving performance (Peeraer & Petegem, 2012). A study by Arnseth and Hatlevik, (2010) on the influence of ICT on teacher-learner interaction in eight secondary schools in Hong Kong found out that posting revision questions, assignments, and lesson notes to students by ICT and Non-ICT trained teachers promoted collaboration, created conducive learning environment, enhanced student-centered learning, and improved the quality of teaching and learning. The utilization of ICT in pedagogy by ICT trained teachers enhanced posting of lesson notes and revision questions to students, individualized interactions, offered a platform for students to construct and share new ideas, improved one on one

communication amongst students thus improved performance and quality of education (Yilmaz, 2011). Comparatively, Non-ICT trained teachers lacked the skills to use ICT tools to conduct online group discussions, online question and answer activities, exchange students work via internet and electronic mails which influenced classroom interaction, students' creativity, and motivation (Khan, Hasan & Clement, 2012).

A study conducted by Sigales, (2013) in 100 Singaporean secondary schools revealed that ICT use in pedagogy by ICT proficient teachers supported a variety of teacher-learner interactive strategies hence intensive rapport between the instructors and students, innovative teaching, collaborative learning hence efficient and effective teaching. Teo, Fan and Du (2015) posited that technology application in teacher-learner interaction by both ICT and Non-ICT trained teachers resulted to more informed class room discussions and debates, in-depth conversations and exchange of ideas; which enabled learners seek clarification on abstract educational concepts, thus upgrading their performance.

According to Barak, (2014) Non-ICT trained teachers were unable to conduct interactive class activities like; online group discussions and individualized interaction, video conferencing and skyping with students, online question and answer approach, and exchange of educational materials via attachment and texts which minimized their interaction with learners. Similarly, employment of technology by ICT and Non-ICT trained teachers did not enable skyping and video conferencing amongst teachers and students as well as exchange of students' written work and learning materials via internet due to insufficient time and broad curriculum limiting learner participation in classroom activities (Barak, 2014).

Farrell and Rushby (2016) alluded that the application of ICT tools by ICT trained teachers made it possible for them to conduct online question and answer sessions, online group discussions, and student individualized interaction; this facilitated students to work in pairs, discuss divergent educational concepts and ideas, and discover new knowledge. On the contrary, Non-ICT trained teachers were found to possess inadequate ICT skills to conduct online based interactive class activities which limited the teacher-learner rapport, students' motivation thus influencing pedagogical efficacy (Magbagbeola, 2012).

Studies by Turel and Johnson (2012), in South America revealed that the utilization of technology by ICT trained teachers empowered teacher-learner interaction which is basic in the educational process; this enhanced collaborative working, students' proactivity in the learning process, quality online discussion and debate, development of elaborate cognitive strategies, construction and acquisition of new knowledge through online interaction hence quality education. According to Bertram and Waldrip, (2013) in Australian secondary schools, the use of digital resources, interactive instructional courseware, and multimedia applications by ICT trained teachers led to multi-sensory stimulation, exchange of students' written work, posting questions and information via electronic mails, interactive learning environment, and intensified class room dialogue thus quality education.

A case study of 18 secondary schools conducted by Magbagbeola (2012) in Nigeria showed that Non-ICT trained teachers did not embrace the application of technologies in class activities which made teachers the transmitters of knowledge and students the recipients; this resulted to minimal class interactions and exchange of ideas, less

student's creativity and motivation, poor teachers' innovation which affected the quality of education and students' performance.

Chisalita and Cretu (2012) argued that ICT integration in teacher-learner interaction by ICT and Non-ICT trained teachers enabled them to post revision materials, additional lesson notes, and assignments to students which elevated their involvement in the teaching and learning system alongside encouraging in-depth understanding of the subject content. Similarly, Conole (2013) found out that the utilization of ICT apparatus by ICT trained teachers enabled effective one on one classroom communication, exchange of educational materials via internet, which made students appreciate the advantages of classroom cohesiveness, and collaboration thus constructing new knowledge. It was in the light of this that, this study sought to establish the impact of ICT integration on teacher-learner interaction of ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

2.7 Summary of the reviewed literature

The reviewed literature in the above parts shows that ICT incorporation has inferences on teachers' pedagogical practices. The assessment components evaluated included: ICT use on content preparation, ICT use on content delivery, ICT use on content assessment, and ICT use on teacher-learner interaction by teachers. Fruitful union of ICT in pedagogy is highly reliant on teachers training towards technology application.

Studies by Sigales, (2013); Badri, (2014); Tezci, (2011); and Erdogan, (2011) revealed that ICT use in pedagogy by ICT and Non-ICT trained teachers enhanced their ability to prepare schemes of work, lesson plans, lesson notes, lesson attendance sheets, records of work, and access to variant information for quality resources and innovative teaching impacting on their pedagogical exercises.

Analyzed empirical studies showed that ICT use in content delivery by ICT and Non-ICT trained teachers enabled classroom technology-based games, role play and imagery resources, use of variant digital formats like; PowerPoint slides, video and audio/sound clips, simulations, graphics, and drawing diagrams which influenced their pedagogical practices (Capan, 2012; Turel & Johnson, 2012; Pruet, Ang & Farzin, 2014). Studies by Howard, (2013); Alazam, (2013); and Tsai and Chai, (2012) found that ICT use in content assessment practices by teachers elevated the levels, tools, and methods of evaluating and measuring students learning outcomes in the educational process thus heightening their pedagogy.

Empirical studies showed that the integration of ICT on teacher-learner interaction enhanced online classroom discussions, online individualized interaction, promoted teacher-learner one on one communication hence building consensus thus impacting on the pedagogical practices of both ICT and Non-ICT trained teachers (Bertram & Waldrip, 2013; Barak, 2014; Teo, Fan & Du, 2015).

The assessed empirical studies indicated that ICT merging matrix must be appraised by the examination of several variables that convey on pedagogy. Studies have clearly conveyed that ICT unification positively affects the pedagogical execution by teachers. These studies are limited to the extremely progressive nations with huge educational budgets, exemplary ICT infrastructure, eminently advanced initial teacher training, and teacher professional progress plans requiring the application of ICT. There is limited regional research carried out on ICT integration and teachers' pedagogical practices.

Two key gaps in the research literature stood out. First, in Africa, despite the affirmation that ICT is an aqueduct for learning and must be a constituent of pedagogy for improved quality of teaching, there is little body of literature on the impact of ICT on teachers' pedagogical processes (Magbagbeola, 2012). The literature reviewed is indicative of a dearth of empirical evidence of adequate pre-service and in-service ICT training to ensure that teachers fully combine ICT in their pedagogical methods. Developing countries have undergone structural changes in their teacher training to ensure that they produce teachers who can apply technology in the classroom despite financial challenges. Second, in Kenya, while efforts to integrate ICT in pedagogy have been done, scholarly researches are scarce which evaluate the impact of ICT usage on teachers' pedagogical practices. This study therefore intended to fill these gaps.

2.8 Theoretical framework

The research was anchored on Diffusion of Innovation Theory (DIT) propounded by Rogers (2003). This theory investigates technology adoption by individuals in a social system. Rodgers (2003) described diffusion as the procedure in which an innovation is disseminated through numerous communication channels over time amongst members of a social system. Therefore, Diffusion of Innovation Theory (DIT) is based on four main components which include: innovation, time, communication channels, and social systems. According to Rogers, (2003) individuals should be informed about all the consequences of adopting new ideas to reduce uncertainties. In addition, they should be exposed to the knowledge stage to acquire relevant skills before adopting and implementing an innovation. Rogers (2003) adds that proper communication channels should be employed in creating and sharing information for

an innovation to easily diffuse in a social system. In expounding the theory, Rodgers (2003), argued that the rate of enactment of an innovation in a social structure is determined by: its relative advantage, compatibility, complexity, trialability, and observability. The degree to which an innovation is regarded as comparatively better than the notion it supersedes, consistent with current values and experiences, easy to understand, use, experiment, and produce visible results determines its adoption.

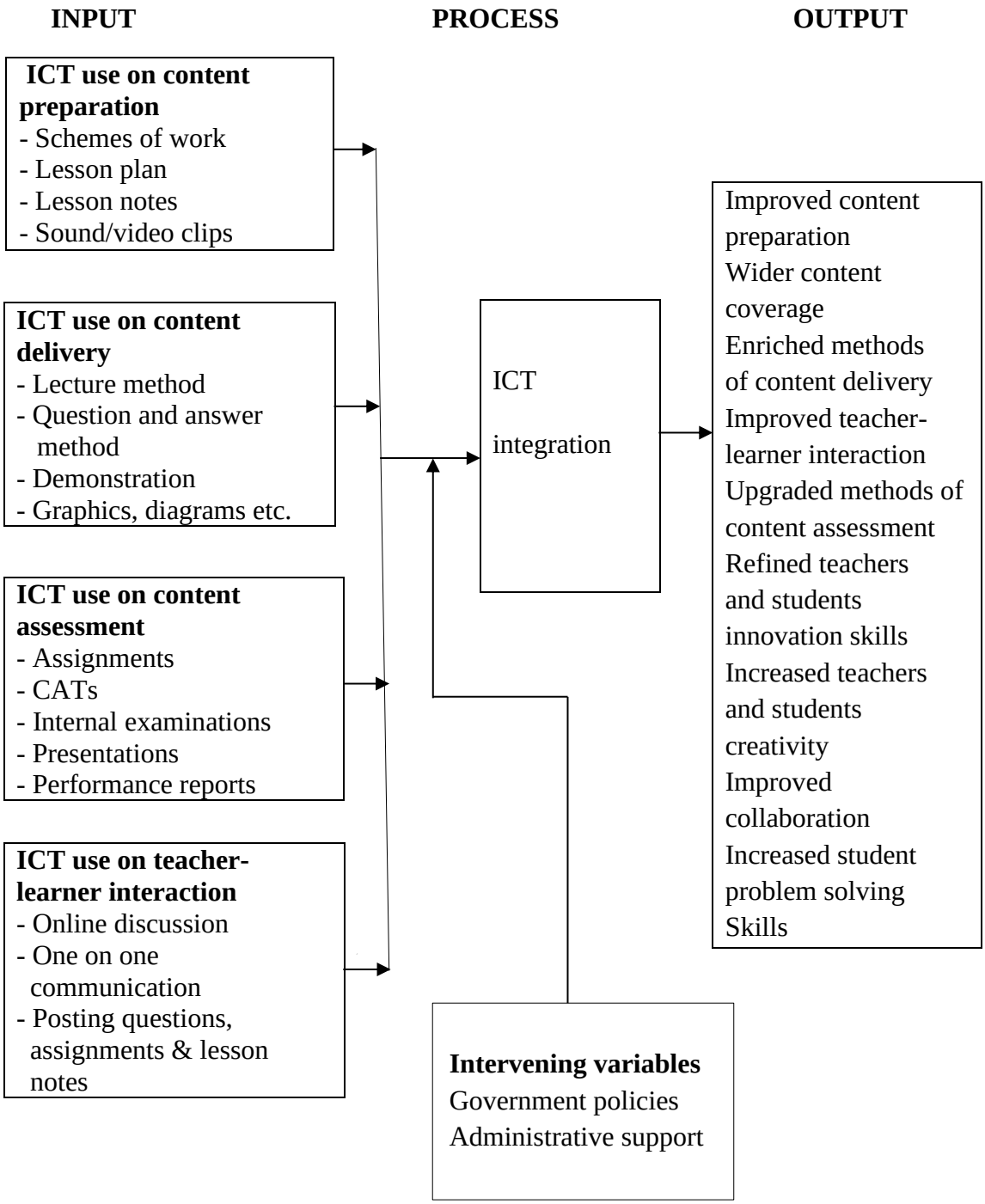
The theory therefore proves compatible to this study in that, educators should understand the importance of utilizing ICT in educational pedagogy for faster adoption of technology in content preparation, content delivery, content assessment, and teacher-learner interaction. Teachers must also be trained on the appropriate application of technology in pedagogy for successful adoption and integration. All the Information Communication Technologies (ICTs) applied for the creation, storage, display, sharing, and information communication should be properly used by teachers and students for successful adoption of ICT in pedagogy. The more advantageous, compatible, simpler, testable, and observable ICT will be to teachers and students the lower the uncertainty, therefore the higher the degree of adopting it in pedagogy.

In reference to Rogers (2003), the innovation is devel**o**ped over a period of time by educators which enable them to prepare teaching content and disseminate to the recipients in the teaching and learning method in the school as a social system. The relative advantage of usage of ICT in teachers' pedagogical practices is that it inculcates creativity amongst teachers and learners, enhances learner participation, collaboration, as well as facilitating search of new and variant information important for learning compared to conventional teaching. The use of ICT innovation as advanced by the current study is compatible with the existing teaching and learning

structures in the current education system; through trialability ICT has produced observable learning outcomes. Further, all the interrelated units in the social system should work jointly for successful diffusion of an innovation. The Ministry of Education, ICT training agencies, principals, teachers, and students should actively play their role for outstanding combination of ICT in teachers' pedagogical forms, thus quality education.

This theory is further ideal for this study since it puts into consideration all aspects which determine the adoption of an innovation in a social process. However, the adoption of fresh ideas doesn't occur simultaneously in a social process, some individuals are more apt to adopt an innovation than others, thus the characteristics of the targeted population ought to be analysed for faster diffusion of an innovation. This study was founded on this theory as it sought to investigate the impact of ICT amalgamation on teachers' pedagogical processes by ICT and Non-ICT trained teachers.

2.9 Conceptual framework



Key: **H_1 - Hypothesis One**
H_2 - Hypothesis Two
H_3 - Hypothesis Three
H_4 - Hypothesis Four
H_5 - Hypothesis Five

Figure 2.1: Relationship of variables showing the impact of ICT integration on teachers' pedagogical practices

The conceptual framework for this study presents the segments of assessing the impact of ICT integration on teachers' pedagogical practices that encompass the independent variables. They incorporate; ICT use on content preparation, ICT use on content delivery, ICT use on content assessment, and ICT use on teacher-learner interaction. The four variables which comprise the teacher's pedagogical practices (inputs) are greatly impacted by ICT integration which forms the dependent variable (process). This establishes a manifesto for measuring the magnitude of ICT merging on pedagogy (output).

The utilization of ICT on content preparation impacts on the teachers' pedagogical enactment resulting to improved content preparation, refined teachers and students' innovation skills, and increased teachers and students' creativity. Furthermore, the application of ICT on teachers' methods of content delivery impacts on their pedagogical practices. Consequently, this leads to wider content coverage, enriched methods of content delivery, and boosts teachers' creativity.

Similarly, the employment of ICT on content assessment by teachers heightens their pedagogics, which results to upgraded methods of content assessment, increased student problem solving skills, and refined teachers and students' innovation skills. ICT usage on teacher-learner interaction elevates the teachers' pedagogical activities; this is evident through improved teacher-learner interaction, improved collaboration, and increased teachers and students innovative and creative skills. Conclusively, the integration of ICT on teachers' content preparation, content delivery, content assessment, and teacher-learner interaction impact greatly on their pedagogical practices heightening the quality of education.

The conceptual framework also presents the intervening variables such as government policy and administrative support which are likely to influence the strength of the relationship between the independent and dependent variables, thus impacting on the study results. These variables will be restrained by ensuring conformity to the government ICT policy on secondary education, and ensuring that the school administration provides the relevant support to enhance the utilization of ICT in pedagogy.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter dealt with the research methodology applied in this study. It focused on the study design, target population, sample size and sampling procedure, research instruments, validity and reliability of the research instruments, data collection procedures, data analysis techniques, and ethical considerations in data collection.

3.2 Study design

The study employed descriptive survey design. Descriptive survey design was applied in the study involving all the secondary schools' principals, teachers, and students in Machakos County to achieve its objectives. The study considered and involved the collection of extensive data on the subject to produce a better understanding of the entity being studied.

Descriptive survey design was selected for this study since it allowed the researcher to describe characteristics of a particular individual, or group (Creswell, 2014). It enabled the collection of information about teachers' attitudes, opinions, values, and behaviors. Since it involved the process of gaining insights into the general picture of a situation, by studying variables in their natural set up, it was used to collect quantitative data (Gay & Araisian, 2003).

The study critically evaluated the impact of ICT fusion on teachers' pedagogical procedures via the views of the principals, teachers, and students. It examined the impact of ICT merging on teachers' pedagogical execution of ICT and Non-ICT trained teachers in Machakos County secondary schools. In addition to the study design, the researcher presented the population targeted for the study.

3.3 Target population

Target population is a large population from which a sample population is selected (Kothari, 2019). In accordance to the County Director of Education (CDE), and the County Director Teacher Management (CDTM) office Machakos, (2018), there were 8 Sub-Counties in Machakos County with a total of 328 secondary schools and an equal number of principals, 3600 teachers and 95,200 students. The principals, teachers and students in Machakos County formed the target population for this study. The universal target population was 99,128 respondents.

In addition to the population targeted for the study, the researcher illustrated how the study's sample size was attained and showed the sampling techniques applied.

3.4 Sampling techniques and sample size

According to (Kothari, 2019), a sample size is a representation of a small part of the target population. The 328 principals/secondary schools and 3,600 teachers were stratified into eight Sub-Counties within Machakos County each with its corresponding number of teachers. To calculate the sample sizes of the principals, teachers, and students, the formula availed by Yamane (2007) was applied.

The formula was preferred since it gave a justifiable representation of the sample size of respondents in a given population. The formula was demonstrated below:

$$n = \frac{N}{1 + N(e)^2}$$

Where n = Sample size
N = Population size
e = The level of precision (sample error) where confidence level is 95% and p is 5%

Substituted for students $n = \frac{N}{1 + N(e)^2}$

Substituted for principals $n = \frac{N}{1 + N(e)^2}$

Substituted for teachers $n = \frac{N}{1 + N(e)^2}$

Where n = Sample size
N = Population size
e = sample error
N = 95,200 Students

$$n = \frac{95{,}200}{1 + 95{,}200\,(0.05)^2}$$

n = 398 students

Where n = Sample size
N = Population size
e = sample error
N = 328 Principals

$$n = \frac{328}{1 + 328\,(0.05)^2}$$

n = 180 Principals (schools)

Where n = Sample size
N = Population size
e = sample error
N = 3600 Teachers

$$n = \frac{3600}{1 + 3600\,(0.05)^2}$$

n = 360 Teachers

Ratio proportionate sampling was applied to get the sample size of the principals and teachers in each Sub-County. The sample size for the principals and teachers was computed as a proportion of the County schools' principals and teachers target population (N), taken as a proportion of the entire target population (N=328) for principals and (N=3600) for teachers, against (×) the sample size of the number of principals (n=180) and (n=360) for teachers respectively as derived from Yamane calculated sample size. The preamble of the target population and sample size of principals and teachers according to their category is depicted in Table 3.1.

Table 3.1 Target population and sample size of principals and teachers

Secondary schools, principals and teachers	**Schools/ Principals (N)**	**Sample size for principals (N/328×180) = (n)**	**Teachers (N)**	**Sample size for teachers (N/3600×360) = (n)**
Yatta	48	26	550	55
Masinga	28	15	378	38
Kathiani	30	16	403	41
Mwala	72	40	681	65
Kangundo	32	17	412	42
Matungulu	28	15	395	40
Athi River	25	14	365	37
Machakos	65	37	416	42
Totals	**∑(N) 328**	**∑(n) 180**	**∑(N) 3600**	**∑(n)360**

Source: Machakos County Director of Education (CDE) Office
Machakos County Director Teacher Management (CDTM) Office

This gave a sample size of 180 principals/secondary schools and 360 teachers. Random sampling method was applied to choose the secondary schools in the Sub-Counties. After stratification, ratio proportionate sampling method was employed to choose teachers in the sampled secondary schools who were proportionally distributed as presented in Table 3.1. At school level, the teachers were stratified into ICT and Non-ICT trained, random sampling method was utilized to choose the teachers to participate in the study. Gender was also considered at for equal representation.

The collective sample size of the students was 398. The total number of students was allocated equally among the sampled secondary schools in each Sub-County using equal allocation method. Thus ($398/180 = 2.2 \approx 2$ students). Two students from each sampled secondary schools were involved in the study. Due to indivisibility of the number of students against the number of schools, 2 students were sampled from 142 ($142 \times 2 = 284$) schools while 3 students were sampled from 38 schools ($38 \times 3 = 114$) totaling to 398 students. Random sampling was done to select the schools where, either two or three students took part in the study. At school level, the students were sampled from form three and four respectively for they had had a relatively longer period of interaction with teachers' pedagogical practices. In mixed schools' gender was considered when selecting the students where one boy and one girl were sampled. The principals, teachers, and students were chosen from the same sampled secondary schools resulting to a universal sample size of 938 respondents.

Having discussed the study design, target population, and the sampling techniques and sample size for the study, the researcher explained the research instruments employed in collecting data for the study.

3.5 Research instruments

The data for this study was gathered by use of questionnaires, observation schedule, and document analysis guide. The questionnaires had closed ended items which yielded quantitative data. Questionnaires validated efficient utilization of time since information was gathered from a huge number of respondents and evoked particular responses from the respondents (Keith, 2009). Questionnaires were used to collect information from the school principals, teachers, and students on the impact of teachers' ICT integration in their pedagogical processes. The questionnaires were structured to cover all the study objectives and any other relevant information necessary for the study.

Observation schedule and document analysis guide were also used as instruments for this study. They served to triangulate the data collected from the questionnaires. The researcher observed the teachers as they interacted with the students using technology-oriented approaches. The documents analyzed included; teachers' spreadsheets, PowerPoint projection slides, soft copy of diagrams, result analysis sheets, mailed students examinations, assignments, exercises, and lesson notes, students' progressive record reports and worksheets, handouts, lesson plans, schemes of work, records of work, visual or audio videos, games and role play clips, animations, simulations, and graphic clips.

The researcher further illustrated how the pilot study for the study was carried out and its significance to the study.

3.6 Pilot study

A pilot study was undertaken to tryout the research instruments. It involved 18 principals, 36 teachers, and 40 students chosen from other schools not sampled in the

study, in accordance to Creswell (2007) who suggested that in big samples at least 10% of the sample forms an agreeable pilot sample. The pilot study was used to establish if there was ambiguity in any of the elements, if the research tools were capable of gathering the expected data, if the statements in the research instruments were distinct, and the questions were appropriately worded. More specifically the pilot study aimed at determining the validity and reliability of the research tools.

3.6.1 Validity of the research instruments

According to Keith (2009) validity of a research instrument is the extent to which an instrument measures what it proposes to measure. Founded on the analysis of the pilot study, corrections, alterations, and additions to the questionnaires were made. In content validity comprehensive comparative studies were undertaken on the subject to be able to come up with appropriate instruments. Out of the pilot sample; 10 of principals were found to be in schools with ICT trained teachers, while 8 were in schools with Non-ICT trained teachers. For the teachers the ICT trained were 24 while Non-ICT trained were 12. For students, those in ICT trained schools were 28 while in Non-ICT trained schools were 12. They were issued with the instruments while the researcher waited and collected them for processing. From the review of the pilot research study, modifications and corrections were made to the questionnaires.

For the observation schedule and document analysis guide, a pilot study was done by the researcher at a later date to ascertain the instruments. The instruments were also subjected to analysis by experts from the Department of Educational Foundations; School of Education, University of Nairobi who ensured their relevance to achieve the expected outcome. The propositions which were made at the pilot testing stage were integrated in the concluding content of the instruments.

3.6.2 Reliability of the research instrument

Gay and Airasian, (2003) posits that reliability of an instrument is a measure of the level to which a research instrument produces constant outcome of data after many tests. To accelerate the reliability of the instruments, test re-test practice for the questionnaires was done. 18 principals, 36 teachers, and 36 students were applied for reliability trying. The questionnaires were administered to the principals, teachers, and students. The responses were then scored.

The same questionnaires were administered to the very same respondents after a span of two weeks keeping all original terms regular (Kothari, 2019). The responses were then scored again. The scores from both trial sessions were correlated to obtain the co-efficient of stability using the Pearson's Product Moment. The test scores for ICT trained teachers were 0.812 while for Non-ICT trained teachers was 0.452. According to Creswell (2014), a co-efficient of stability of between 0.5 and 0.99 is sufficient to offer reliable results.

The Pearson's Product Moment formula was applied as follows: -

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma x^2 - (\Sigma X)^2][NY^2 - (\Sigma Y)^2]}}$$

Where;

N = Number of scores

X = First set of scores

Y = Second set of scores

XY = Sum of the first product of the first and second scores

$\sum x$ = Sum of first set of scores

$\sum y$ = Sum of second set of scores

$\sum x2$ = Sum of square of the first set of score

For the Observation schedule a pre-test observation was done on the sampled items.

Later, member check analysis was carried out to clarify on issues which were not clear. For the documents analysis guide recording and re-recording was done for clarity of any uncertain matters emerging from the pre-test.

Having clarified on how the validity and reliability of the research tools was determined, the researcher outlined the data collection processes considered for the study.

3.7 Data collection procedures

The researcher sought research permit from the National Council for Science Technology and Innovation (NACOSTI) before commencing on the research. Permission was also sought from Machakos County Director of Education (CDE). The researcher employed the services of two research assistants to help distribute and collect the filled questionnaires from schools.

Data collection began with administration of the questionnaires. The researcher afterwards conducted the observation check schedule, and document analysis. The researcher booked appointments with the school principals to obtain data from students, teachers and principals. On arrival at the schools on the scheduled dates, the researcher created rapport with the respondents, explained to them the aim of the study, and then administered the research instruments. Class visits, observation, and document analysis was done for the researcher to experience the merger of ICT in teachers' pedagogical exercises.

The researcher further expounded on the data analysis techniques applied for the study.

3.8 Data analysis techniques

Kothari (2019), contends that data analysis is the procedure of summarizing the collected data and combining it so that the researcher would emphatically arrange, classify, and synthesize information from the data collecting instruments. Data collected was edited for accuracy, uniformity, and consistency and then organized to facilitate coding and analysis. The data from the respondents was incorporated and a comparative analysis of the responses was presented. The outcomes of the comparative review of the study responses were cross tabulated and orderly compared for similarities and variations.

Quantitative data was analyzed applying descriptive and inferential statistics by the use of the Statistical Package for Social Sciences (SPSS). Descriptive data comparing the analysis of ICT and Non-ICT trained teachers was presented in percentages and frequency distribution tables. Pearson's Product Moment Correlation Coefficient (r) was used to determine the level, strength, and direction of the connection amid ICT integration and teachers' pedagogical practices for both ICT and Non-ICT trained teachers.

The value of the coefficient of the correlation (r) ranges from, $-1 \leq r \leq 1$. A correlation of zero indicated no relationship at all between the independent and dependent variables while values close to zero meant a weak relationship between ICT integration and teachers' pedagogical practices. A value higher than 0 indicated a positive interrelationship; that is, as ICT integration increased so did teachers' pedagogical practices. Values of (r) close to 1 indicated a very strong relationship between ICT integration and teachers' pedagogical practices.

The (r) value was squared to obtain the coefficient of determination (r^2) which was a statistical measure that determined the proportion of variance in teachers' pedagogical practices that could be described by ICT integration in their pedagogy. A value of (r^2) between 0 and 1 indicated the extent to which the teachers' pedagogical practices were predictable. The nearer the value was to 1, the better was the association between ICT integration and teachers' pedagogical practices. All the four independent variables and dependent variables regression yielded different (r^2) values for both ICT and Non-ICT trained teachers.

Pearson chi test was used to present and interpret the inferential data. Pearson chi test showed the degree of independence that was employed to ascertain the levels of significance of the correlation amongst ICT integration and teachers' pedagogical practices. The acceptable level of significance was 0.05 at 1 extent of freedom.

Degrees of significance deemed to be higher than alpha (p) 0.05 implied that there is no statistically significant influence at all amid ICT integration and teachers' pedagogical practices. A value of (p) less than 0.05 indicated a strong level of significance between ICT integration and teachers' pedagogical practices. On all the four hypotheses, a standard significance of between 0.00 and 0.05 was used for rejecting or upholding the research hypotheses.

Pearson chi test was necessary for this research to determine the level of significance between teachers' integration of ICT (Predictor variable) and their pedagogical practices (Observed outcomes). The Chi test yielded different significant (p) values for both ICT and Non-ICT trained teachers.

Responses from the observation schedule were organized into themes in line with the study objectives and integrated with the rest of the data for purposes of triangulation. The information from the document analysis guide was grouped into themes according to the research objectives for triangulation purposes and corroboration of data from other research instruments.

Finally, the researcher showed the ethical considerations observed when conducting the study.

3.9 Ethical considerations

Ethical considerations are an integral part of any research. This study upheld ethical issues by seeking for permission to conduct research from NACOSTI, County offices, Sub-County offices, and the school management at school level. This ensured that the research was undertaken within the legal framework of conducting research in learning institutions.

The researcher also sought for participants' informed concession and willingness participation. This ensured that the respondents gave the required information willingly. Rapport with the respondents was created by discussing with them the aim of the research study; this enabled easy access of the intended information from the respondents.

Confidentiality and anonymity were also maintained by guaranteeing the respondents that their identity would not to be made public. This hastened the process of data collection and made the respondents cooperate. The researcher acknowledged the source of information by mentioning citations and providing a list of references of the source of information used in the entire document to be devoid of plagiarism that provided trustworthiness to the research study.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND PRESENTATION

4.1. Introduction

This chapter presented study findings based on the objectives of the research study. The chapter was organized into the following sections; instrument return rate, demographic information of the respondents, ICT integration in teachers' pedagogy, data analysis based on study objectives and hypothesis testing.

4.2 Instrument return rate

The study sought information on the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. A total number of 180 questionnaires were administered to principals, 360 to the teachers, and 398 to the students in the sampled secondary schools in Machakos County. The instrument return rate distribution from the various respondents was as presented in Table 4.1.

Table 4.1 Instruments return rate

Respondents	Sample targeted	Response return rate (n)	Percentage (%)
Principals	180	160	88.9
Teachers	360	350	97.2
Students	398	380	95.5

The information presented in Table 4.1 showed that, 88.9 percent of school principals, 97.2 percent of the teachers, and 95.5 percent of the students responded satisfactorily to the questionnaires. The instrument return rate was not 100 percent because the researcher used research assistants to distribute the questionnaires to the sampled secondary schools. The researcher found the return rates adequate according to Kothari (2019) who postulates that a return rate of 60 percent and above is acceptable.

The researcher personally went round all the sampled schools filling the observation schedule and conducting documentary analysis recording a return rate of 100 percent.

4.3 Analysis of demographic information and related data

The study sought demographic information of the principals and teachers on their category of school, gender, age, academic qualification, and their teaching experience. Students' demographic information comprised of their category of school, gender, and age. The study sought for the demographic information in order to understand the characteristics of the respondents which would aid to explain the impact of ICT integration on teachers' pedagogical practices in secondary schools. Their responses were summarized and presented in the Tables below.

4.3.1 Category of schools

To begin with the study sought to establish the respondents' category of schools. This was meant to ensure that all types of schools were captured in the study, for balanced representation of the ICT pedagogical experiences of ICT and Non-ICT trained teachers. This information was obtained from the principals, teachers, and students. The results of the school categories in Machakos County were as presented in Table 4.2.

Table 4.2 Categorization of schools

Category of schools	Frequency (n)	Percentage (%)
National schools	2	1.2
Extra-County schools	38	23.8
County schools	61	38.1
Sub-County schools	59	36.9
Total	**160**	**100**

The data contained in Table 4.2 revealed that 38.1 percent of the schools sampled were County schools, 36.9 percent were Sub-County schools, 23.8 percent were

Extra-County schools, and only 1.2 percent represented National schools. The results implied that Machakos County had all categories of schools as per the MOE school categorization. This would assist in giving a comprehensive data on the trend of acquisition of pre-service and in-service ICT training for the teachers, as well as the utilization of ICT in their pedagogical practices across the County. From the analysis 61.9 percent of the schools were Extra-County and County schools which implied that the principals were able to provide ICT tools for use by teachers in their pedagogical practices due to availability of finances. In addition, this implied variation in the respondents' views regarding exposure to ICT based pedagogy resulting to all-inclusive data.

4.3.2 Gender of respondents

The study also sought information on the respondent's gender in order to check on participation of both male and female respondents in the study, and bring out diversity of opinion on the use of ICT in teachers' pedagogical practices. The gender of the respondents was of interest to the study because it provided information on the ICT training and Non-ICT training opportunities offered to female and male teachers of secondary schools. In addition, gender of the teachers was vital to ensure demonstration of both genders' competence on the incorporation of ICT in their pedagogical processes.

The students, teachers, and principals were as requested to indicate their gender. The responses were as summarized in Table 4.3.

Table 4.3 Gender of respondents

	Students		Teachers		Principals	
Gender	**n**	**%**	**n**	**%**	**n**	**%**
Male	182	48	216	61.7	88	55
Female	198	52	134	38.3	72	45
Total	**380**	**100**	**350**	**100**	**160**	**100**

The data captured in Table 4.3 indicated that both genders participated in the study. The gender of the students comprised of 48 percent male and 52 percent female. This implied that both genders participated in the study which was an indicator that both male and female students participated and experienced ICT integrated pedagogy. The teachers' gender distribution comprised of 38.3 percent being female and 61.7 percent male. The gender difference for the teachers was large an indication that male teachers were exposed to either pre-service or in-service ICT training, or were Non-ICT trained compared to female teachers in Machakos County. In addition, this implied that male teachers were more involved in the utilization of ICT in pedagogy compared to female teachers due to the males' immense interest in technological applications.

For the school principals, 55 percent were male while 45 percent were female. The gender difference was minimal an implication that either gender participated in the facilitation of in-service ICT training for the teachers, provision of ICT facilities and growth of school ICT procedures to lead in the integration of ICT in teachers' pedagogical practices.

4.3.3 Age of respondents

Further the study sought to identify the age of the respondents. Their age was a necessary pointer to show the degree of support and receptiveness in ICT training and

its use in teaching and learning given that ICT was a recent inclusion in pedagogy. The age was also important to show divergence on the respondents' views and abilities to integrate ICT in their pedagogical practices.

The students, teachers, and principals were supposed to indicate their age bracket. The outcomes were presented in Table 4.4.

Table 4.4 Age of respondents

	Students		**Teachers**		**Principals**	
Age bracket	**n**	**%**	**n**	**%**	**n**	**%**
13-16 years	344	90.5	0	0	0	0
17-19 years	36	9.5	0	0	0	0
21-30 years	0	0	134	34.1	15	9.5
31-40 years	0	0	116	33.3	90	56.3
41-50 years	0	0	96	27.4	46	28.6
Above 50 years	0	0	4	1.2	9	5.6
Total	**380**	**100**	**350**	**100**	**160**	**100**

The information presented in Table 4.4 revealed that 90.5 percent of the students were within age bracket 13-16 years while 9.5 percent were within 17-19 years age bracket. This could be attributed to fact that in Kenya most of the learners join secondary school at age bracket 13-14 years, and complete form four at 18 years of age except a few exceptional cases. The students were fairly distributed across all ages which implied presence of varied views on the utility of ICT based pedagogy.

For the teacher's 34.1 percent were in ages between 21-30 years, 33.1 percent were in ages between 31-40 years, 27.4 percent were aged between 41-50 years while the rest 1.2 percent were above 50 years. This showed that most of the teachers were at their constructive age (21-50 years), had valuable knowledge of ICT whether formally or informally, hence able to practically integrate it in pedagogy.

For the principals, 9.5 percent were aged between 21-30 years, 56.3 percent were aged between 31-40 years, and 28.6 percent were between ages 41-50 years while 5.6 percent were above 50 years. This implied that most of the principals were conversant with the contemporary educational trends, possessed ICT skills and therefore receptive to digital technologies, hence could support teachers' initiative in the utilization of ICT in pedagogy.

4.3.4 Teachers and principals' academic qualifications

The academic qualification of the teachers and principals was also sought. This information was intended to establish the principals' expertise in the management of ICT facilities and use of digital technology in pedagogy by teachers; as well as the teachers' competence in the application of ICT in their pedagogical practices. The teachers and principals were asked to specify whether they had Diploma in education (DE), Bachelor of Education Arts (B.Ed. Arts), Bachelor of Education Science (B.Ed. Science), Bachelor of Education IT (B.Ed. IT), Master of Education (M.Ed.), and Doctor of Philosophy (PhD). The responses were as presented in Table 4.5.

Table 4.5 Academic qualification of teachers and principals

Academic qualifications	**Teachers**		**Principals**	
	n	**%**	**n**	**%**
Diploma in Education	66	18.8	0	0
B.Ed. Arts	100	28.6	68	42.5
B.Ed. Science	84	24	38	23.8
B.Ed. IT	35	10	0	0
Master in Education	65	18.6	54	33.7
PhD	0	0	0	0
Total	**350**	**100**	**160**	**100**

From the information provided in Table 4.5 it was evident that 28.6 percent and 24 percent of the teachers had B.Ed. Arts and B.Ed. Science degrees respectively. Similarly, 42.5 percent and 23.8 percent of the principals had B.Ed. Arts and B.Ed.

Science degrees respectively which are considered as qualifications for secondary school teachers. In addition, 18.6 percent of the teachers and 33.7 percent of the principals had Master of Education qualification. The data also displayed that 18.8 percent of the teachers had Diploma in Education qualification. The data implied that all secondary school principals in Machakos County had the basic qualifications to teach in secondary schools as required by the TSC policy. The data further meant that the teachers and principals had the professional competence and capacity to merge ICT in their pedagogical processes to some extent whether formally or informally trained.

The distribution also signified that 10 percent of the teachers had B.Ed. IT implying that they had the required training and competence to spearhead the implementation of the schools ICT policies. They could also offer technical assistance and professional guidance to the teachers and principals in their endeavor to combine ICT in their pedagogical practices.

4.3.5 Teaching experience of teachers and principals

The study further sought to ascertain the years of teaching experience for the teachers and principals. The respondents' teaching experience was aimed at determining their level of experience in teaching as well as utilization of ICT in their pedagogical processes. The teachers and principals were asked to indicate their years of service as teachers. The results were presented in Table 4.6.

Table 4.6 Teaching experience of teachers and principals

	Teachers		Principal	
Responses	**Frequency (n)**	**Percentage (%)**	**Frequency (n)**	**Percentage (%)**
0-5 years	84	24	0	0
6-10 years	117	33.4	0	0
11-15 years	77	22	77	48
16-20 years	43	12.3	53	33
0ver 20 years	29	8.3	30	19
Total	**350**	**100**	**160**	**100**

The analysis presented in table 4.6 showed that 24 percent of the teachers had served between 0-5 years, 33.4 percent for 6-10 years, and 22 percent had served for 11-15 years. This implied that the teachers were young, with sufficient knowledge and expertise on ICT application and integration in their pedagogical practices. In addition, 12.3 percent and 8.3 percent of the teachers had served for 16-20 years and over 20 years respectively. This was an indication that the teachers had sufficient pedagogical experience and expertise that could allow ICT amalgamation in teaching and learning.

Similarly, 48 percent of the principals had been in the service for 11-15 years, 33 percent for 16-20 years, while 19 percent had over 20 years of service. None of the principals had served for 0-10 years. This signified that the principals had served for a period long enough to develop competence in school pedagogical management, and could competently supervise ICT integration in pedagogy in their schools which was an emerging issue in the school curriculum.

Having analyzed the respondents' demographic and related data, the study focused on data analysis to establish the ICT status in secondary schools.

4.4. Analysis of ICT status in secondary schools

This section aimed at establishing the ICT status in secondary schools. This included: formal ICT training of teachers for the comparative purposes of the study, execution of ICT policy in secondary schools, adequacy of ICT equipment in secondary schools, extent of knowhow and frequency of teachers' usage of ICT apparatus in their pedagogical exercise.

4.4.1 Formal ICT training of teachers

This section aimed at establishing whether the teachers were ICT trained or Non-ICT trained to serve the comparative intent of the study. The study was meant to investigate whether the teachers had undergone formal ICT training for effective integration of ICT in pedagogy. The aim was to establish the number of ICT trained and Non-ICT trained teachers in the secondary schools. It also helped in establishing the secondary schools with ICT and Non-ICT trained teachers.

The teachers were asked to indicate whether they had undergone formal ICT training, whether pre-service or in-service training. Similarly, the principals were asked to indicate whether teachers in their schools had undergone formal pre-service or in-service ICT training. The outcomes were presented as depicted in Table 4.7.

Table 4.7 Formal ICT training of teachers

	Teachers		**Principals**	
ICT training	**Frequency (n)**	**Percentage (%)**	**Frequency (n)**	**Percentage (%)**
ICT trained teachers	210	60	96	60
Non-ICT trained teachers	140	40	64	40
Total	**350**	**100**	**160**	**100**

The data contained in Table 4.7 indicated that 60 percent of the teachers confirmed that they had undergone formal ICT training while 40 percent had not undergone formal ICT training on the application of ICT in pedagogy. Similarly, 60 percent of the principals said that their teachers were formally trained on ICT use compared to 40 percent of the principals who said that their teachers were not formally trained on ICT use in pedagogy.

This implied that secondary school teachers in Machakos County were exposed to either pre-service or in-service ICT training on the utilization of ICT in their pedagogical practices as indicated by the presence of ICT trained teachers. In addition, the analysis indicated that pedagogical ICT training had not been fully embraced in Machakos County due to the presence of Non-ICT trained teachers. This justified the presence of ICT and Non-ICT trained teachers in the secondary schools of Machakos County.

4.4.2 Implementation of ICT policy in secondary schools

In relation to strategies towards ICT integration by the ICT and Non-ICT trained teachers, the study sought to establish whether there were ICT policies to guide the usage of ICT equipment and their impact on ICT integration in pedagogy. The school ICT policies outlined comprehensible objectives and mechanisms of realizing them for successful ICT use in teachers' pedagogical practices.

The teachers and principals were asked to indicate whether their schools had ICT policies. The results were as summarized in Table 4.8.

Table 4.8 Teachers' and principals' responses to the availability of ICT policy in secondary schools

	Teachers				Principals			
	ICT trained		Non-ICT trained		Schools with ICT trained teachers		Schools with Non-ICT trained teachers	
Responses	**N**	**%**	**n**	**%**	**N**	**%**	**n**	**%**
Yes	158	75.2	25	17.9	77	80.2	16	25
No	52	24.8	115	82.1	19	19.8	48	75
Total	**210**	**100**	**140**	**100**	**96**	**100**	**64**	**100**

As indicated in Table 4.8, 75.2 percent of ICT trained teachers, and 80.2 percent of the principals of schools with ICT trained teachers confirmed that their schools had ICT policies which guided the usage and application of technology in their pedagogical practices compared, to 17.9 percent of Non-ICT trained teachers and 25 percent of principals of schools with ICT trained teachers who had similar views. On the contrary, 82.1 percent of Non-ICT trained teachers, and 75 percent of the principals of schools with Non-ICT trained teachers said that their schools did not have ICT policies, compared to 24.8 percent of ICT trained teachers and 19.8 percent of principals of schools with Non-ICT trained teachers who had similar views.

This was an indication that most of the schools had ICT policies which guided the teachers in merging their subject content with technology for full incorporation of ICT in pedagogy. This ensured that both ICT and Non-ICT trained teachers fully embraced the incorporation of ICT in their teaching and learning practices. Secondary schools with Non-ICT trained teachers lacked ICT policies an indication that the teachers lacked guidelines on the usage of ICT which challenged their adoption of technology in pedagogy.

4.4.3 The impact of ICT policy on the integration of ICT in teachers' pedagogical practices

In relation to the availability of ICT policies in schools it was of significance to investigate how the school ICT policies determined ICT integration in pedagogy.

This study therefore sought the teachers and principals' views on how the ICT policies impacted on their endeavor to integrate ICT in pedagogy. Their responses were as presented in Table 4.9.

Table 4.9 Teachers and principals' views on the impact of ICT policy on ICT integration in teachers' pedagogical practices

	Teachers				**Principals**			
	ICT trained		**Non-ICT trained**		**Schools with ICT trained teachers**		**Schools with Non-ICT trained teachers**	
Responses	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Very influential	85	40.5	11	7.9	41	42.7	6	9.4
Influential	75	35.7	29	20.7	40	41.7	13	20.3
Less influential	35	16.7	54	38.5	10	10.4	25	39
Not influential	15	7.1	46	32.9	5	5.2	20	31.3
Total	**210**	**100**	**140**	**100**	**96**	**100**	**64**	**100**

The data contained in Table 4.9 showed that 40.5 percent and 35.7 percent of ICT trained teachers were of the view that the school ICT policies were very influential and influential respectively on the efforts of ICT integrating in their pedagogical practices compared to 7.9 percent and 20.7 percent of Non-ICT trained teachers who had the same view respectively. Similarly, 42.7 percent and 41.7 percent of the principals of schools with ICT trained teachers said that the school ICT policies were very influential and influential respectively towards achievement of the schools' vision of integrating ICT in pedagogy compared to 9.4 percent and 20.3 percent of their counterparts in schools with Non-ICT trained teachers.

On the contrary, 38.5 percent and 32.9 percent of Non-ICT trained teachers were of the view that the ICT policies were less influential and not influential respectively in regard to the incorporation of ICT to teaching and learning. In addition, 39 percent and 31.3 percent of the principals of schools with Non-ICT trained teachers had similar views respectively. Only 16.7 percent and 7.1 percent of ICT trained teachers; 10.4 percent and 5.2 percent of principals of schools with ICT trained teachers felt that ICT policies were less influential and not influential towards teachers ICT integration in pedagogy respectively.

This was an implication that school ICT policies impacted more on the ICT trained teacher's integration of ICT on their pedagogical practices compared to Non-ICT trained teachers. The principals being the supervisors of curriculum implementation ensured that the ICT and Non-ICT teachers executed the ICT policies for maximum utilization of ICT in their pedagogical practices hence quality education.

4.4.4 Adequacy of ICT equipment in secondary schools

In addition to ICT training and the availability of ICT policies in schools, efficient integration of ICT in pedagogy would highly be determined by the adequacy of ICT equipment. Therefore, the study strived to determine the adequacy of ICT equipment in the schools by seeking the views of the principals and teachers.

The principals were requested to indicate their opinions on the adequacy of ICT equipment in their schools. They were requested to indicate their responses as; VA=Very Adequate, A=Adequate, and NA=Not Adequate. The results were as contained in Table 4.10.

Table 4.10 Principals views on the adequacy of ICT equipment in secondary schools

	Principals															
	Schools with ICT trained teachers								Schools with Non-ICT trained teachers							
Responses	**VA**		**A**		**NA**		**TOTAL**		**VA**		**A**		**NA**		**TOTAL**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Internet availability	80	83.3	12	12.6	4	4.2	**96**	**100**	35	54.6	9	14.1	20	31.3	**64**	**100**
Smart phones	74	77.1	22	22.9	0	0	**96**	**100**	56	87.5	6	9.4	2	3.1	**64**	**100**
Digital cameras	48	50	24	25	24	25	**96**	**100**	30	46.9	16	25	18	28.1	**64**	**100**
Video cameras	58	60.4	20	20.8	18	18.8	**96**	**100**	18	28.1	30	46.9	16	25	**64**	**100**
LCD projectors	44	45.9	20	20.8	32	33.3	**96**	**100**	12	18.8	8	12.5	44	68.8	**64**	**100**
Computers/ laptops	76	79.2	14	14.6	6	6.2	**96**	**100**	34	53.1	10	15.6	20	31.3	**64**	**100**
Tablets	50	52.1	22	22.9	24	25	**96**	**100**	22	34.3	12	18.8	30	46.9	**64**	**100**
Radios/TVs	44	45.9	20	20.8	32	33.3	**96**	**100**	12	18.8	22	34.3	30	46.9	**64**	**100**
White boards	90	93.8	6	6.2	0	0	**96**	**100**	30	46.9	12	18.8	22	34.3	**64**	**100**
Smart boards	90	93.8	6	6.2	0	0	**96**	**100**	22	34.3	12	18.8	30	46.9	**64**	**100**

The analysis presented in Table 4.10 revealed that 83.3 percent, of the principals of schools with ICT trained teachers indicated that internet availability was very adequate compared to 54.6 percent of the principals of schools with Non-ICT trained teachers who had similar views. 4.2 percent of the principals of schools with ICT trained teachers felt that internet availability was not adequate, while 31.3 percent of the principals of schools with Non-ICT trained teachers felt the same. In addition, 77.1 percent, and 22.9 percent of the principals of schools with ICT trained teachers indicated that their schools had very adequate and adequate smartphones respectively; similarly, 87.5 percent, and 9.4 percent of the principals of schools with Non-ICT trained teachers felt that their schools had very adequate and adequate smartphones respectively.

Further, the analysis indicted that, 50 percent, and 60.4 percent of the principals of schools with ICT trained teachers indicated that digital cameras and video cameras were very adequate respectively compared to 28.1 percent, and 25 percent of their counterparts who had the view that the same ICT equipment were not adequate respectively. It was evident that, 68.8 percent of the principals of schools with Non-ICT trained teachers said that LCD projectors in their schools were not adequate compared to 45.9 percent of their counterparts who had the view that LCD projectors in their schools were very adequate. In addition, only 6.2 percent, and 25 percent of the principals of schools with ICT trained teachers who felt that computers/laptops and tablets were not adequate, compared to 31.3 percent, and 46.9 percent of the principals of schools with Non-ICT trained teachers who had similar views.

Similarly, 33.3 percent of the principals of schools with ICT trained teachers and 46.9 percent of the principals of schools with Non-ICT trained teachers indicated that radios/TVs in their schools were not adequate. None of the principals of schools with ICT trained teachers showed that whiteboards and smart boards were not adequate compared to 34.3 percent, and 46.9 percent of the principals of schools with Non-ICT trained teachers who felt that the equipment were not adequate respectively.

This implied that schools with ICT trained teachers were more endowed with ICT equipment compared to the schools with Non-ICT trained teachers which influenced their utilization of ICT in pedagogy variedly. The principals of schools with ICT trained teachers had made notable efforts to ensure that the schools had ICT equipment for use in pedagogy compared to their counterparts which imparted differently on the teachers' pedagogical practices.

Similarly, the study sought the views of the teachers in relation to the adequacy of ICT equipment in the schools. They were requested to indicate their responses as; VA=Very Adequate, A=Adequate, and NA=Not Adequate. The results were as presented in Table 4.11.

Table 4.11 Teachers views on the adequacy of ICT equipment in secondary schools

	Teachers															
	ICT trained								**Non-ICT trained**							
Responses	**VA**		**A**		**NA**		**TOTAL**		**VA**		**A**		**NA**		**TOTAL**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Internet availability	160	76.2	26	12.4	24	11.4	**210**	**100**	89	63.6	31	22.1	20	14.3	**140**	**100**
Smart phones	199	94.8	11	5.2	0	0	**210**	**100**	63	45	49	35	28	20	**140**	**100**
Digital cameras	100	47.6	54	25.7	56	26.7	**210**	**100**	19	13.6	30	21.4	91	65	**140**	**100**
Video cameras	109	51.9	33	15.7	68	32.4	**210**	**100**	52	37.1	46	32.9	42	30	**140**	**100**
LCD projectors	102	48.6	59	28.1	49	23.3	**210**	**100**	25	17.9	27	19.3	88	62.8	**140**	**100**
Computers/ laptops	148	70.5	33	15.7	29	13.8	**210**	**100**	75	53.6	22	15.7	43	30.7	**140**	**100**
Tablets	100	47.6	56	26.7	54	25.7	**210**	**100**	52	37.1	46	32.9	42	30	**140**	**100**
Radios/TVs	109	51.9	33	15.7	68	32.4	**210**	**100**	25	17.9	27	19.3	88	62.8	**140**	**100**
White boards	189	90	21	10	0	0	**210**	**100**	28	20	63	45	49	35	**140**	**100**
Smart boards	199	94.8	11	5.2	0	0	**210**	**100**	28	20	49	35	63	45	**140**	**100**

The information captured in Table 4.11 indicated that 76.2 percent and 12.4 percent of ICT trained teachers had the view that internet availability was very adequate and adequate respectively, compared to 63.6 percent and 22.1 percent of Non-ICT trained teachers who felt the same respectively. However, 11.4 percent of ICT trained teachers said that internet availability was not adequate compared to 14.3 percent of Non-ICT trained teachers who had similar vies. 94.8 percent of ICT trained teacher said that they had very adequate smartphones compared to 45 percent of their

counterparts who felt the same. None of the ICT trained teachers said that smartphones were not adequate compared to 20 percent of Non-ICT trained teachers who indicated that smartphones in their schools were not adequate. On the contrary, 65 percent and 30 percent of Non-ICT trained teachers indicated that digital cameras and video cameras were not adequate respectively; compared to 47.6 percent and 51.9 percent of ICT trained teachers who felt that digital cameras and video cameras were very adequate respectively.

In addition, 48.6 percent of ICT trained teachers said that they had very adequate LCD projectors compared to 17.9 percent of Non-ICT trained teachers who had similar views. 62.8 percent of Non-ICT trained teachers said that the LCD projectors were not adequate while 23.3 percent of ICT trained teachers felt the same. 70.5 percent and 15.7 percent of ICT trained teacher indicated that computers/laptops were very adequate and adequate respectively, while 53.6 percent and 15.7 percent of Non-ICT trained teachers had similar views respectively. Similarly, 47.6 percent and 26.7 percent of ICT trained teachers felt that tablets in their schools were very adequate and adequate respectively compared to 37.1 percent and 32.9 percent of Non-ICT trained teachers who felt the same respectively.

The analysis further showed that 62.8 percent of Non-ICT trained teachers said that radios/TVs were not adequate, compared to 32.4 percent of ICT trained teachers who had similar views. None of the ICT trained teachers indicated that white boards and smart boards were not adequate, while 35 percent and 45 percent of Non-ICT trained teachers said that the same ICT equipment were not adequate respectively. This meant that ICT trained teachers were better placed to extensively integrate ICT in teaching and learning compared to Non-ICT trained teachers due to the adequacy of ICT

equipment in their schools. The presence of internet, computers/laptops, smart phones and other ICT equipment for the Non-ICT trained teachers indicated that to some extent they were able to utilize ICT in their pedagogy.

Having analyzed the adequacy of ICT equipment in the schools, the study further sought to establish the teachers' knowhow on the usage of the ICT equipment in their pedagogical practices.

4.4.5 Teachers' knowledge on the use of ICT equipment in their pedagogical practices

In relation to the adequacy of ICT equipment in schools, it was important to explore the teachers' level of knowledge on the use of ICT equipment. This information was important because it would determine the extent of teachers' utilization of ICT equipment in their pedagogical practices, which was the main focus of the study. The study therefore sought to establish teachers' knowhow on the use of ICT software and equipment in pedagogy. To this effect, the respondents were asked to rate the teachers' knowledge on the use of ICT software and equipment in their pedagogical practices.

The principals' views on teachers' knowhow on the use of ICT software and equipment in their pedagogical practices were as presented in Table 4.12.

Table 4.12 Principals views on teachers' knowledge on the use of ICT software and equipment in their pedagogical practices

	Principals of schools with ICT trained teachers								Principals of schools with Non-ICT trained teachers							
Responses	**V. good**		**Good**		**Fair**		**Total**		**V. good**		**Good**		**Fair**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Ability to use Microsoft Word	82	85.4	12	12.5	2	2.1	**96**	**100**	58	90.6	4	6.3	2	3.1	**64**	**100**
Ability to use Microsoft Excel	58	60.4	20	20.8	18	18.8	**96**	**100**	30	46.9	18	28.1	16	25	**64**	**100**
Ability to use Microsoft PowerPoint	76	79.2	20	20.8	0	0	**96**	**100**	2	3.1	12	18.8	50	78.1	**64**	**100**
Ability to use internet	84	87.5	8	8.3	4	4.2	**96**	**100**	54	84.4	8	12.5	2	3.1	**64**	**100**
Ability to use smart phones	90	93.8	6	6.2	0	0	**96**	**100**	56	87.5	6	9.4	2	3.1	**64**	**100**
Ability to use digital cameras	76	79.2	14	14.6	6	6.2	**96**	**100**	50	78.1	8	12.5	8	12.5	**64**	**100**
Ability to use video cameras	80	83.3	10	10.5	6	6.2	**96**	**100**	50	78.1	11	17.2	3	4.7	**64**	**100**
Ability to use LCD projectors	60	62.5	33	34.4	3	3.1	**96**	**100**	12	18.8	22	34.3	30	46.9	**64**	**100**
Ability to use computers/ laptops	65	67.8	25	26	6	6.2	**96**	**100**	16	25	40	62.5	8	12.5	**64**	**100**
Ability to use tablets	75	78.1	15	15.7	6	6.2	**96**	**100**	10	15.6	44	68.8	10	15.6	**64**	**100**

The information captured in Table 4.12 revealed that 85.4 percent and 60.4 percent of the principals of schools with ICT trained teachers stated that the teachers were very good in the use of Microsoft word and Microsoft excel respectively; similarly, 90.6 percent and 46.9 percent of the principals of schools with Non-ICT trained teachers had similar views. To the contrary 78.1 percent of the principals of schools with Non-ICT trained teachers felt that the teachers were fair on the use of Microsoft PowerPoint, while none of the principals of schools with ICT trained teachers felt the same. In addition, 79.2 percent of the principals of schools with ICT trained teachers said that the teachers were very good in the use of Microsoft PowerPoint, compared to

only 3.1 percent of the principals of schools with Non-ICT trained teachers who had similar views.

The analysis further indicated that 87.5 percent and 93.8 percent of the principals of schools with ICT trained teachers stated that the teachers were very good in the use of internet and smart phone respectively; similarly, 84.4 percent and 87.5 percent of the principals of schools with Non-ICT trained teachers indicated the same respectively. None percent of the principals of schools with ICT trained teachers had the view that teachers were fair in the use of smartphone compared to 3.1 percent of their counterparts who felt the same. In addition, 6.2 percent of the principals of schools with ICT trained teachers felt that the teachers were fair in the use of digital and video cameras compared to 12.5 percent and 4.7 percent of their counterparts who had similar views respectively.

Further the information indicated that, 3.1 percent of the principals of schools with ICT trained teachers said that the teachers were fair on the use of LCD projectors compared to 46.9 percent of the principals of schools with Non-ICT trained teachers who had similar views. On the same, 62.5 percent of the principals of schools with ICT trained teachers indicated that teachers were very good on the use of LCD projectors compared to 18.8 percent of their counterparts who felt the same. Further, 62.5 percent of the principals of schools with Non-ICT trained teachers felt that the teachers were good in the use of computers/laptops, while 26 percent of their counterparts shared similar sediments. The teachers' ability to use tablets was satisfactory as indicated by 68.8 percent of the principals of schools with Non-ICT trained teachers who said that the teachers were good in tablet usage and 78.1 percent

of the principals of schools with ICT trained teachers who indicated that the teachers were very good in tablet usage.

This denoted that both ICT and Non-ICT trained teachers were knowledgeable on the application and use of some ICT equipment which greatly influenced their pedagogical practices. The Non-ICT trained teachers despite not having formal pedagogical pre-service or in-service ICT training had privately acquired general ICT knowledge on the use of some ICT equipment which enhanced their pedagogy. The great variations in the knowhow on the usage of Microsoft PowerPoint, LCD projectors implied that the ICT trained teachers had acquired adequate pre-service and in-service training on the use of ICT equipment in pedagogy compared to the Non-ICT trained teachers who were incompetent on the use of some ICT equipment in teaching and learning which influenced their pedagogical practices.

These results support the work of Kampylis and Punie (2013) who noted that ICT trained teachers in Canada were effective in the use of ICT tools in their classroom activities as opposed to Non-ICT trained teachers who avoided integrating technology in their teaching and learning due to inability to select appropriate ICT equipment and develop ICT content based on their subject matter.

The teachers were also requested to rate their knowhow on the use of ICT software and equipment in their pedagogical practices. The results were as summarized in Table 4.13.

Table 4.13 Teachers' views on their knowledge on the use of ICT software and equipment in their pedagogical practices

	ICT trained teachers								Non-ICT trained teachers							
Responses	**V. good**		**Good**		**Fair**		**Total**		**V. good**		**Good**		**Fair**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Ability to use Microsoft Word	169	80.5	26	12.4	15	7.1	**210**	**100**	109	77.9	24	17.1	7	5	**140**	**100**
Ability to use Microsoft Excel	120	57.1	52	24.8	38	18.1	**210**	**100**	28	20	63	45	49	35	**140**	**100**
Ability to use Microsoft PowerPoint	170	81	31	14.7	9	4.3	**210**	**100**	19	13.6	30	21.4	91	65	**140**	**100**
Ability to use internet	189	90	21	10	0	0	**210**	**100**	108	77.1	28	19.9	4	3	**140**	**100**
Ability to use smart phones	142	67.8	59	28	9	4.2	**210**	**100**	126	90	8	5.7	6	4.3	**140**	**100**
Ability to use digital cameras	187	89	23	11	0	0	**210**	**100**	105	75	22	15.5	13	9.5	**140**	**100**
Ability to use video cameras	179	85.4	26	12.6	5	2	**210**	**100**	127	90.7	9	6.4	4	2.9	**140**	**100**
Ability to use LCD projectors	129	61.5	68	32.4	13	6.2	**210**	**100**	25	17.9	27	19.3	88	62.8	**140**	**100**
Ability to use computers/ laptops	199	94.8	11	5.2	0	0	**210**	**100**	120	85.7	14	10	6	4.3	**140**	**100**
Ability to use tablets	164	78.1	29	13.8	17	8.1	**210**	**100**	22	15.7	108	77.1	10	7.2	**140**	**100**

The data contained in Table 4.13 showed that 80.5 percent of ICT trained teachers confirmed that they were very good in the use of Microsoft word, while 77.9 percent of Non-ICT trained teachers said that they were also very good in the use of Microsoft word. Only 7.1 percent of ICT trained teachers and 5 percent of Non-ICT trained teachers felt that they were fair in the use of Microsoft word. In addition, 20 percent and 45 percent of Non-ICT trained teachers had the view that they were very good and good in the use of Microsoft excel respectively compared to 57.1 percent and 24.8 percent of ICT trained teachers who had similar views respectively.

To the contrary, 65 percent of Non-ICT trained teachers indicated that they were fair in the use of Microsoft PowerPoint compared to 4.3 percent of ICT trained teachers who felt the same; 81 percent of ICT trained teachers felt that they were very good in the use of Microsoft PowerPoint compared to 13.6 percent of Non-ICT trained teachers who had similar views. Similarly, the analysis indicated that 90 percent of ICT trained teachers and 77.1 percent of Non-ICT trained teachers were very good in the use of the internet; none of ICT trained teachers said that their ability to use internet was fair compared to 3 percent of Non-ICT trained teachers who had similar views.

The data also showed that 89 percent and 85.4 percent of ICT trained teachers had the feeling that they were very good in the use of digital and video cameras respectively compared to 75 percent and 90.7 percent of Non-ICT trained teachers who had similar feelings respectively. Similarly, 67.8 percent of ICT trained teachers and 90 percent of Non-ICT trained teachers were very good in the use of smartphones. To the contrary, 62.8 percent of Non-ICT trained teachers felt that they were fair in the use of LCD projector compared to 6.2 percent of ICT trained teachers who felt the same. None of the ICT trained teachers indicated that they were fair in the use of computers/laptops compared to 4.3 percent of Non- ICT trained teachers who had similar views. The data also showed that 78.1 of ICT trained teachers had the view that they were very good in the use of tablets compared to 15.7 percent of Non-ICT trained teachers who had similar views. 77.1 of Non-ICT trained teachers indicated that they were good in the use of tablets compared to 13.8 percent of ICT trained teachers who felt the same.

The views of the teachers concurred with those of the principals that both ICT and Non-ICT trained teachers were knowledgeable on the utilization of some ICT equipment. This was an indication that both ICT and Non-ICT trained teachers' utilized ICT equipment in their pedagogical practices though with variations which boosted their classroom activities hence improving the quality of education. In addition, the data demonstrated great variations in the application of some ICT equipment; this implied that ICT trained teachers had acquired relevant ICT pedagogical skills through appropriate ICT training which influenced their pedagogics more compared to the Non-ICT trained teachers. This corroborates with studies done by Vieluf, Kaplan and Bayer, (2013) who found that teachers who were knowledgeable on ICT usage in pedagogy conducted meaningful lessons and exhibited expansive teaching potential compared to Non-ICT trained teachers who lacked sufficient expertise to incorporate ICT and pedagogy.

In addition to the principals and teachers views on the teachers' knowhow on the use of ICT software and equipment, the researcher carried out an observation schedule on the teachers' use of ICT software and equipment in their pedagogy. The findings were as shown in Table 4.14.

Table 4.14 Observation results on teachers' knowledge on the use of ICT software and equipment in pedagogy

	ICT trained teachers						Non-ICT trained teachers					
Responses	**Used**		**Not used**		**Total**		**Used**		**Not used**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Use of Microsoft Word by teachers	210	100	0	0	**210**	**100**	140	100	0	0	**140**	**100**
Use of Microsoft Excel by teachers	210	100	0	0	**210**	**100**	60	42.9	80	57.1	**140**	**100**
Use of Microsoft PowerPoint by teachers	210	100	0	0	**210**	**100**	30	21.4	110	78.6	**140**	**100**
Use of internet by teachers	210	100	0	0	**210**	**100**	80	57.1	60	42.9	**140**	**100**
Use of LCD projectors by teachers	200	95	10	5	**210**	**100**	30	21.4	110	78.6	**140**	**100**
Use of computers/laptops by teachers	210	100	0	0	**210**	**100**	120	85.7	20	14.3	**140**	**100**
Use of smart phones/tablets by teachers	189	90	21	5	**210**	**100**	90	64.3	50	35.7	**140**	**100**
Use of digital cameras by teachers	200	95	10	5	**210**	**100**	40	28.6	100	71.4	**140**	**100**
Use of video cameras by teachers	189	90	21	10	**210**	**100**	45	32.1	95	67.9	**140**	**100**

The results presented in Table 4.14 from the observation of teachers' knowhow on the use of ICT equipment in pedagogy indicated that 100 percent of both ICT and Non-ICT trained teachers were knowledgeable on the use of Microsoft word. In addition, 100 percent of ICT trained teachers used Microsoft Excel, Microsoft PowerPoint, and internet compared to 57.1 percent, 78.6 percent, and 42.9 percent of Non-ICT trained teachers who were found not using the same ICT software respectively. All the ICT trained teachers were able to use computers/laptops compared to 85.7 percent of Non-ICT trained teachers who were found using computers/laptops, while 14.3 percent were not knowledgeable on the use of computers/laptops.

To the contrary, 78.6 percent and 71.4 percent of ICT trained teachers were not found using LCD projectors and digital cameras respectively compared to only 5 percent of ICT trained teachers who could not use the same ICT equipment respectively.

Similarly, 90 percent of ICT trained teachers and 64.3 percent of Non-ICT trained teachers used smartphones/tablets; while 5 percent of ICT trained teachers and 35.7 percent of Non-ICT trained teachers were not found using the same ICT equipment respectively. The use of video cameras had variations where 10 percent of ICT trained teachers were not using them compared to 67.9 percent of Non-ICT trained teachers who could not use the same ICT equipment.

This implied that ICT trained teachers were more equipped with ICT pedagogical skills and knowledge which influenced their intense use of ICT equipment in teaching and learning compared to Non-ICT trained teachers who minimally used ICT equipment in pedagogy due to lack of adequate and relevant ICT pedagogical training. This concurs with studies done by Spektor-Levy and Granot-Gilat, (2012) who found that Non-ICT trained teachers in the United Kingdom were unable to select appropriate ICT tools and prepare digital content which hindered their content preparation, assessment and coverage, access to a wider range of information, collaboration, and networking with other instructors. The teachers who were exposed to technological pedagogy recorded reputable teacher-learner interaction, access to new and variant educational materials, wider content coverage, and distinct understanding of complex concepts.

4.4.6 Frequency of teachers' use of ICT equipment in their pedagogical practices

Alongside the level of knowhow on the use of ICT equipment by teachers, it was considered significant to enquire the frequency of use of ICT equipment by teachers in their teaching and learning activities. This data could provide an account and a basis of evaluating the influence of ICT integration on teachers' pedagogical practices which was the gist of the study.

In relation to this, the study sought to establish the frequency of teachers' use of ICT software and equipment in their pedagogical practices. The principals, teachers, and students were requested to indicate the frequency with which teacher's integrated ICT software and equipment in their pedagogical practices.

The responses of the principal's views on the frequency of teachers' use of ICT software and equipment in their pedagogical practices were as presented in Table 4.15.

Table 4.15 Principals views on the frequency of teachers' use of ICT software and equipment in their pedagogical practices

	ICT trained teachers								**Non-ICT trained teachers**							
Responses	**Daily**		**Weekly**		**Monthly**		**Termly**		**Daily**		**Weekly**		**Monthly**		**Termly**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Microsoft Word	54	56	43	45	5	5	0	0	0	0	0	0	27	42.2	37	57.8
Microsoft Excel	48	50	38	40	10	10	0	0	0	0	0	0	20	31.3	44	68.7
Microsoft PowerPoint	43	44.8	34	35.4	19	19.8	0	0	0	0	0	0	14	21.9	50	78.1
Internet	86	89.6	10	10.4	0	0	0	0	51	79.7	10	15.6	3	4.7	0	0
Smart phones	49	51	47	49	0	0	0	0	35	54.7	16	25	19	29.7	3	4.7
Digital cameras	34	35.4	47	49	15	15.6	0	0	26	40.6	22	34.4	7	10.9	0	0
Video cameras	46	47.9	36	37.5	14	14.6	0	0	22	34.4	24	37.5	15	23.4	3	4.7
LCD projectors	43	44.8	34	35.4	19	19.8	0	0	0	0	0	0	14	21.9	50	78.1
Computers/ laptops	86	89.6	10	10.4	0	0	0	0	0	0	11	17.2	22	34.4	31	48.4
Tablets	43	44.8	48	50	5	5.2	0	0	0	0	0	0	12	18.8	52	81.2
Radios/TVs	0	0	19	19.8	34	35.4	43	44.8	0	0	0	0	20	31.3	44	68.7
White boards	91	94.8	5	5.2	0	0	0	0	26	40.6	22	34.4	7	10.9	0	0
Smart boards	91	94.8	5	5.2	0	0	0	0	26	40.6	22	34.4	7	10.9	0	0

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n =64. % = 100)

From the analysis captured in Table 4.15 it is evident that 56 percent and 45 percent of the principals of schools with ICT trained teachers had the view that teachers used

Microsoft word daily and weekly respectively, while none of the principals of schools with Non-ICT trained teachers had similar views. 42.2 percent of the principals of schools with Non-ICT trained teachers indicated that teachers used Microsoft word monthly, compared to 5 percent of their counterparts who indicated the same respectively. None of the principals of schools with ICT trained teachers had the view that teachers used Microsoft word termly compared to 57.8 percent of the principals of schools with Non-ICT trained teachers who indicated that teachers used Microsoft word termly respectively.

None of the principals of schools with Non-ICT trained teachers were of the view that teachers used Microsoft excel daily and weekly compared to 50 percent and 40 percent of the principals of schools with ICT trained teachers who said that teachers used Microsoft excel daily and weekly respectively. In addition, 44.8 percent and 35.4 percent of the principals of schools with ICT trained teachers had the view that teachers used Microsoft PowerPoint daily and weekly respectively, while none of the principals of schools with Non-ICT trained teachers indicated that respectively. 78.1 percent of the principals of schools with Non-ICT trained teachers said that teachers used Microsoft PowerPoint termly while none of their counterparts had similar views.

Similarly, 89.6 percent of the principals of schools with ICT trained teachers said that teachers used internet daily compared to 79.7 percent of their counterparts who felt the same. None of the principals of schools with ICT trained teachers indicated that teachers used smartphones monthly and termly compared to 29.7 percent and 4.7 percent of their counterparts who said that teachers used smartphones monthly and termly respectively. None of the principals of either category had the view that teachers used digital cameras termly; likewise, 35.4 percent and 49 percent of the

principals of schools with ICT trained teachers said that teachers used digital cameras daily and weekly respectively, compared to 40.6 percent and 34.4 percent of the principals of schools with Non-ICT trained teachers who indicated the same respectively. Similarly, 37.5 percent of principals of both categories had the view that teachers used video cameras weekly in pedagogy.

To the contrary, 78.1 percent of the principals of schools with Non-ICT trained teachers had the view that teachers used LCD projectors termly, while none of the principals of schools with ICT trained teachers had the same view. In addition, 44.8 percent and 35.4 percent of the principals of schools with ICT trained teachers said that teachers used LCD projectors daily and weekly in their pedagogical practices, while none of the principals of schools with Non-ICT trained teachers indicated the same. Further, the data indicated that 89.6 percent of the principals of schools with ICT trained teachers had the view that teachers used computers/laptops daily in pedagogy, while none of their counterparts felt the same. None of the principals of schools with ICT trained teachers said that teachers used computers/laptops termly compared to 48.4 percent of the principals of schools with Non-ICT trained teachers who said that teachers utilized computers/laptops termly in teaching and learning.

The information also showed that 81.2 percent of the principals of schools with Non-ICT trained teachers had the view that teachers used tablets termly, while none of their counterparts indicated the same. None of the principals of schools with Non-ICT trained teachers said that teachers used tablets weekly compared to 50 percent of the principals of schools with ICT trained teachers who showed the same. None of the principals of either category indicated that teachers used radios/TVs daily in pedagogy. 35.4 percent and 44.8 percent of the principals of schools with ICT trained

teachers said that teachers used radios/TVs monthly and termly respectively, compared to 31.3 percent and 68.7 percent of the principals of schools with Non-ICT trained teachers who felt the same respectively. None of the principals of either category indicated that teachers used white boards and smart boards termly in teaching and learning. Similarly, 94.8 percent of the principals of schools with ICT trained teachers said that teachers used white boards and smart boards daily in pedagogy, compared to 40.6 percent of the principals of schools with Non-ICT trained teachers who indicated the same respectively.

This implied that ICT trained teachers applied ICT tools in their pedagogical practices more frequently compared to Non-ICT trained teachers, this could be attributed to formal ICT training, availability, and adequacy of ICT facilities, as well as the levels of implementation of ICT policies in the schools. This elevated their content preparation, presentation, and examination as well as their interaction with learners. The analysis was also as an indication that principals of schools with ICT trained teachers provided ICT equipment and supervised their utilization in pedagogy. The high daily teachers' usage of internet connoted that both ICT and Non-ICT trained teachers used their personal smart phones and data to search educational materials to enhance their teaching and learning process.

The views of the teachers regarding the frequency of use of ICT software and equipment in their pedagogical practices were as illustrated in Table 4.16.

Table 4.16 Teachers views on the frequency of use of ICT software and equipment in their pedagogical practices

	ICT trained teachers								Non-ICT trained teachers							
Responses	**Daily**		**Weekly**		**Monthly**		**Termly**		**Daily**		**Weekly**		**Monthly**		**Termly**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**N**	**%**
Microsoft Word	106	50.5	90	47.1	14	6.6	0	0	0	0	0	0	40	28.6	100	71.4
Microsoft Excel	126	60	84	40	0	0	0	0	0	0	0	0	42	30	98	70
Microsoft PowerPoint	105	50	67	31.9	19	18.1	0	0	0	0	0	0	20	14.3	120	85.7
Internet	179	85	21	10	5	2.4	0	0	112	80	17	12.1	11	7.9	0	0
Smart phones	74	53	66	47	0	0	0	0	70	50	48	34.3	22	15.7	0	0
Digital cameras	69	32.9	95	45.2	30	14.3	16	7.6	53	37.9	34	24.3	43	30.7	10	7.1
Video cameras	95	45	74	35	41	20	0	0	42	30	53	37.9	35	25	10	7.1
LCD projectors	105	50	67	31.9	19	18.1	0	0	0	0	0	0	20	14.3	120	85.7
Computers/ laptops	179	85.2	31	14.8	0	0	0	0	0	0	35	25	50	35.7	55	39.3
Tablets	84	40	109	51.9	17	8.1	0	0	0	0	0	0	28	20	112	80
Radios/TVs	0	0	0	0	66	47	74	53	0	0	0	0	42	30	98	70
Whiteboards	170	80.9	40	19.1	0	0	0	0	75	53.6	40	28.6	25	17.8	0	0
Smart boards	170	80.9	40	19.1	0	0	0	0	75	53.6	40	28.6	25	17.8	0	0

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n =140. % = 100)

The data presented in Table 4.16 indicated that 50.5 percent and 47.1 percent of ICT trained teachers utilized Microsoft Word daily and weekly respectively in their pedagogical practices, while none of the Non-ICT trained teachers used the same software daily or weekly in pedagogy. None of the ICT trained teachers used Microsoft Word termly compared to 71.4 percent of Non-ICT trained teachers who said that they used Microsoft Word termly. The usage of Microsoft Excel had great variations where 30 percent and 70 percent of Non-ICT trained teachers were of the view that they used it monthly and termly respectively compared to 60 percent and 40 percent of ICT trained teachers who used it daily and weekly respectively.

The analysis showed that none of the Non-ICT trained teachers indicated that they employed Microsoft PowerPoint daily and weekly in pedagogy, compared to 50

percent and 31.9 percent of ICT trained teachers who said that they utilized Microsoft PowerPoint daily and weekly respectively. None of the ICT trained teachers used Microsoft PowerPoint termly compared to 85.7 percent of Non-ICT trained teachers who used the software termly. Similarly, 85 percent of ICT trained teachers and 80 percent of Non-ICT trained teachers said that they used internet daily; while none of the ICT and Non-ICT trained teachers indicated that they used internet termly in their pedagogical practices. In addition, 53 percent and 47 percent of ICT trained teachers had the view that they used smartphones daily and weekly respectively compared to 50 percent and 34.3 percent of Non-ICT trained teachers who had similar views respectively. None of the ICT and Non-ICT trained teachers said that they used smartphones termly.

The information also indicated that 7.6 percent of ICT trained teachers and 7.1 percent of Non-ICT trained teachers used digital cameras termly. Similarly, 35 percent of ICT trained teachers and 37.9 percent of Non-ICT trained teachers said that they used video cameras weekly in teaching and learning. To the contrary, none of Non-ICT trained teachers used LCD projectors daily and weekly respectively, compared to 50 percent and 31.9 percent of ICT trained teachers who showed that they used the equipment daily and weekly respectively in pedagogy. None of the ICT trained teachers used LCD projectors termly compared to 85.7 percent of Non-ICT trained teachers who used the equipment termly.

None of the ICT trained teachers had the view that they used computers/laptops monthly and termly in pedagogy compared to 35.7 percent and 39.3 percent of Non-ICT trained teachers who said that they used the equipment monthly and termly in pedagogy respectively. None of Non-ICT trained teachers used computers/laptops

daily compared to 85.2 percent of ICT trained teacher who used them daily in pedagogy. Further 40 percent and 51.9 percent of ICT trained teachers indicated that they utilized tablets daily and weekly, while none of Non-ICT trained teachers had similar views. However, 80 percent of Non-ICT trained teachers said that they used tablets termly while none of the ICT trained teachers indicated the same.

None of the ICT and Non-ICT trained teachers said that they utilized radios/TVs daily and weekly respectively. 47 percent and 53 percent of ICT trained teachers indicated that they used radios/TVs monthly and termly respectively compared to 30 percent and 70 percent of Non-ICT trained teachers who had similar views respectively. In addition, 80.9 percent of ICT trained teachers said that they used white boards and smart boards daily in pedagogy respectively compared to 53.6 percent of Non-ICT trained teachers who had similar views respectively. None of the ICT and Non-ICT trained teachers indicated that they utilized white boards and smart boards termly in teaching and learning.

This meant that ICT trained teachers embraced intense application of technology in their pedagogical practices due to acquisition of formal pedagogical ICT training, adequacy of ICT infrastructure, and intense implementation of school ICT policies which enhanced their pedagogy compared to Non-ICT trained teachers. The comprehensive termly use of Microsoft Word and Microsoft Excel was due to the setting of internal and termly examinations and compiling of students' examination performance reports by both ICT and Non-ICT trained teachers. The analysis also denoted that both ICT and Non-ICT trained teachers utilized the available ICT software and equipment to gather and access variant information from the internet and other educational sources to improve their pedagogical practices. Non-ICT trained

teachers despite not having formal ICT training possessed general technological literacy to use some ICT software and equipment thus upgrading their pedagogical practices.

Further the study sought the views of the students on how frequently their teachers employed ICT software and equipment in their classroom activities. The information was as captured in Table 4.17.

Table 4.17 Students views on the frequency of teachers' use of ICT software and equipment in their pedagogical practices

	Daily		**Weekly**		**Monthly**		**Termly**		**Total**	
Responses	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Microsoft Word	130	34.2	103	27.1	80	21.1	67	17.6	**380**	**100**
Microsoft Excel	114	30	95	25	95	25	76	20	**380**	**100**
Microsoft PowerPoint	102	26.8	76	20	82	21.6	120	31.6	**380**	**100**
Internet	133	35	171	45	40	10.5	36	9.5	**380**	**100**
Smart phones	133	35	76	20	82	21.6	81	23.4	**380**	**100**
Digital cameras	129	33.9	171	45	55	14.5	25	6.6	**380**	**100**
Video cameras	114	30	141	37.1	67	17.6	58	15.3	**380**	**100**
LCD projectors	102	26.8	76	20	82	21.6	120	31.6	**380**	**100**
Computers/laptops	152	40	133	35	59	15.5	36	9.5	**380**	**100**
Tablets	114	30	140	36.8	76	20	50	13.2	**380**	**100**
Radios/TVs	102	26.8	76	20	82	21.6	120	31.6	**380**	**100**
Whiteboards	114	30	141	37.1	67	17.6	58	15.3	**380**	**100**
Smart boards	114	30	141	37.1	67	17.6	58	15.3	**380**	**100**

The results contained in Table 4.17 signified that the views of the students concurred with those of the principals and teachers that both ICT and Non-ICT trained teachers' utilized ICT equipment in their pedagogical practices though with variations. The analysis indicated that 34.2 percent and 30 percent of the students were of the opinion that both ICT and Non-ICT trained teachers used Microsoft word and Microsoft excel daily respectively in their teaching and learning activities. On the contrary, 31.6

percent of the students had the view that both ICT and Non-ICT trained teachers used Microsoft PowerPoint, LCD projectors, and Radios/TVs termly respectively in their pedagogical practices, compared to 26.8 percent who said that both ICT and Non-ICT trained teachers utilized Microsoft PowerPoint, LCD projectors, and Radios/TVs daily respectively in pedagogy.

In addition, 45 percent of the students indicated that both ICT and Non-ICT trained teachers used internet and digital cameras weekly respectively, while 9.5 percent and 6.6 percent indicated that the teachers used internet and digital cameras termly respectively. Further, 40 percent and 35 percent of the students felt that both ICT and Non-ICT trained teachers, utilized computers/laptops daily and weekly respectively, compared to 15.5 percent and 9.5 percent felt that the teachers used computers/laptops monthly and termly respectively. In addition, 35 percent and 30 percent of students indicated that ICT and Non-ICT trained teachers used smart phones and tablets daily respectively, compared to 21.6 percent and 20 percent who felt that the teachers used the equipment monthly respectively. The usage of white boards and smart boards was more frequent with 30 percent and 37.1 percent of the students indicating that both ICT and Non-ICT trained teachers used them daily and weekly respectively, compared to 17.6 percent and 15.3 percent felt that the teachers used the equipment monthly and termly respectively.

This was an indication that Non-ICT trained teachers were ICT literate though they lacked formal ICT training on the application of ICT in pedagogy which influenced their usage of ICT in their classroom activities. On the other hand, the ICT trained teachers had the appropriate ICT training which highly influenced their employment of ICT in their pedagogy.

4.4.7 Document Analysis Results

The study further considered the use of document analysis guide to ascertain the actual ICT status in the secondary schools. The study sought to check store ledgers and inventories to establish the condition of the ICT equipment in secondary schools. The results were as summarized in Table 4.18.

Table 4.18 Condition of ICT equipment in secondary schools

	Schools with ICT trained teachers						**Schools with Non-ICT trained teachers**					
Response	**Serviceable**		**Not Serviceable**		**Total**		**Serviceable**		**Not Serviceable**		**Total**	
	n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Computers/ Laptops	92	95.8	4	4.2	**96**	**100**	44	68.7	20	31.3	**64**	**100**
Tablets	80	83.3	16	16.7	**96**	**100**	34	53.1	30	46.9	**64**	**100**
Digital pens	90	93.8	6	6.2	**96**	**100**	20	31.2	44	68.8	**64**	**100**
Internet	70	73	26	27	**96**	**100**	36	56.3	28	43.7	**64**	**100**
Digital cameras	72	75	24	25	**96**	**100**	46	71.9	18	28.1	**64**	**100**
Video cameras	68	70.8	28	29.2	**96**	**100**	40	62.5	24	37.5	**64**	**100**
LCD projectors	64	66.7	32	33.3	**96**	**100**	20	31.2	44	68.8	**64**	**100**
Radios/TVS	66	68.8	30	31.2	**96**	**100**	22	34.4	42	65.6	**64**	**100**
White boards	96	100	0	0	**96**	**100**	48	75	16	25	**64**	**100**
Smart boards	96	100	0	0	**96**	**100**	40	62.5	24	37.5	**64**	**100**

The data captured in Table 4.18 revealed that 95.8 percent of the schools with ICT trained teachers had computers/laptops which were in good condition compared to 68.7 percent of the schools with Non-ICT trained teachers. However, 4.2 percent of the schools with ICT trained teachers had computers/laptops which were not serviceable compared to 31.3 percent of the schools with Non-ICT trained teachers. It was also found that 83.3 percent of the schools with ICT trained teachers had serviceable tablets compared to 53.1 percent of the schools with Non-ICT trained teachers which had serviceable tablets. However, 46.9 percent of the schools with Non-ICT trained teachers had tablets which were not in condition compared to 16.7

percent of the schools with ICT trained teachers which had non serviceable tablets. 93.8 percent of the schools with ICT trained teachers had serviceable digital pens compared to 31.2 percent of the schools with Non-ICT trained teachers. 6.2 percent of the schools with ICT trained teachers were found not having serviceable digital pens compared to 68.8 of the schools with Non-ICT trained teachers.

Further, 73 percent of the schools with ICT trained teachers had serviceable internet compared to 56.3 percent of the schools with Non-ICT trained teachers. However, 43.7 percent of the schools with Non-ICT trained teachers did not have serviceable internet compared to 27 percent of the schools with ICT trained teachers. Likewise, 75 percent and 70.8 percent of the schools with ICT trained teachers were found having well-conditioned digital and video cameras respectively, compared to 71.9 percent and 62.5 percent of the schools with Non-ICT trained teachers which did not have well-conditioned digital and video cameras respectively. To the contrary, 25 percent and 29.2 percent of the schools with ICT trained teachers did not have serviceable digital and video cameras respectively, compared to 28.1 percent and 37.5 percent of the schools with Non-ICT trained teachers which did not have serviceable digital and video cameras respectively.

In addition, 66.7 percent of the schools with ICT trained teachers had serviceable LCD projectors compared to 31.2 percent of the schools with Non-ICT trained teachers which were found having serviceable LCD projectors. To the contrary, 68.8 percent of the schools with Non-ICT trained teachers did not have serviceable LCD projectors compared to 33.3 percent of the schools with ICT trained teachers. Further, 68.8 percent in of the schools with ICT trained teachers had radios/TVs in good condition compared to 34.4 percent of the schools with Non-ICT trained teachers;

while 31.2 percent of the schools with ICT trained teachers did not have serviceable radios/TVs compared to 65.6 percent of the schools with Non-ICT trained teachers. All the schools with ICT trained teachers had whiteboards and smart boards in good condition respectively, compared to 75 percent and 62.5 percent of the schools with Non-ICT trained teachers which had whiteboards and smart boards in good condition respectively. Likewise, 25 percent and 37.5 percent of the schools with Non-ICT trained teachers did not have whiteboards and smart boards in good condition respectively.

The condition of the ICT equipment differed among the schools with ICT and Non-ICT trained teachers. This denoted that schools with ICT trained teachers had more serviceable ICT equipment which enabled the teachers to fully utilize ICT in pedagogy compared to schools with Non-ICT trained teachers. The principals of school with ICT trained teachers ensured that the available ICT equipment were in good condition which enhanced the teachers use of ICT in pedagogy to implement and achieve the schools ICT policy. The principals of school with Non-ICT trained teachers similarly made efforts to ensure that the ICT equipment were serviceable which influenced the teacher use of ICT in pedagogy. The ICT trained teachers recorded higher percentages of usage of ICT equipment compared to the Non-ICT trained teachers because they had acquired formal pedagogical ICT training which enhanced their usage.

Having comprehensively discussed the ICT status in secondary schools; the study established that teachers ICT training, implementation of ICT policies, adequacy of ICT equipment, teacher's knowhow and frequency of use of ICT software and equipment, and the condition of ICT equipment in secondary schools influenced ICT

and Non-ICT trained teachers' integration of ICT in their pedagogical practices. This gave a picture of the ICT status in secondary schools and informed the number of ICT and Non-ICT trained teachers to serve the comparative purpose of the study. This information was vital for it enabled the researcher to investigate the influence of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers which was the goal of the study.

The study therefore, embarked on its main objectives in order to establish the impact of ICT merger on teachers' pedagogical operations. This section began by expounding the procedure of hypothesis testing and analysis to be applied in the study.

4.5 Hypothesis testing and analysis

The study's hypothesis stated that ICT integration does not significantly impact on teachers' content preparation, content delivery, content assessment, and teacher-learner interaction by ICT and Non-ICT trained teachers in Machakos County secondary schools. To establish the impact of ICT fusion in teachers' pedagogical operations, teachers' knowhow on the use of ICT skills in pedagogy was correlated with the responses from each of the aspects of teachers' pedagogical practices.

Pearson's Product Moment correlation coefficient (r) was used to ascertain the level, the strength and the direction of the connection amid ICT integration and teachers' pedagogical practices. The value of the coefficient of the correlation (r) ranges from $-1 \leq r \leq 1$. A correlation of zero indicated no relationship at all between ICT integration and teachers' pedagogical practices while values close to zero meant a weak relationship between the two variables. A value larger than 0 indicated a positive interrelationship; as the value of ICT integration increased so did teachers'

pedagogical practices. Values of (r) close to 1 indicated a very strong relation between ICT integration and teachers' pedagogical practices.

The (r) value was squared to obtain the coefficient of determination (r^2) which is a statistical measure that ascertains the proportion of variance in the dependent variable that could be described by the independent variable. In this study, it implied the proportion of the variance in the teachers' pedagogical practices that would be predicted or described with ICT integration. ICT integration was the predictor variable that explained the level in which teachers merge ICT in their pedagogical practices. An (r^2) between 0 and 1 indicated the extent to which the dependent variable was predictable. The closer the value was to 1, the better was the association between ICT amalgamation and pedagogical processes application by teachers.

Pearson chi test was applied to ascertain the extent of significance. The agreeable extent of significance for the Pearson chi test was 0.05 at 1 degree of freedom. Degrees of significance found to be higher than 0.05 signified that ICT integration did not influence teachers' pedagogical practices of both ICT trained and Non-ICT trained teachers. On the contrary, levels of significance less than 0.05 indicated that ICT integration influenced teachers' pedagogical practices of both ICT trained and Non-ICT trained teachers.

A *p* value ($p<0.05$) signified that the results were statistically significant. Significance level *(p),* the probability value that forms the boundary between rejecting or upholding the Null hypothesis was used to determine significant levels. A *(p)* value greater than 0.05 led to upholding of the Null hypothesis while (*p)* value less than 0.05, led to rejection of the Null hypothesis.

Having outlined the hypothesis testing and analysis procedure, the first teachers' pedagogical practice investigated was content preparation.

4.6 Data analysis on the impact of ICT integration on content preparation by teachers

The study sought to determine the impact of ICT integration on content preparation by teachers in secondary schools. In line with this objective, the respondents were requested to indicate their views on teacher's usage of ICT skills when preparing content for their lessons.

4.6.1 Analysis of Principals', Teachers', and Students' views on teachers' use of ICT skills in content preparation

The principals, teachers, and students were asked to indicate their level of agreement on teachers' usage of ICT competencies in content preparation. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results of the principals' opinion on teacher's application of ICT skills in content preparation were as contained in Table 4.19.

Table 4.19 Principal's views on teachers' use of ICT skills in content preparation

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use ICT to prepare schemes of work	84	87.5	12	12.5	0	0	0	0	0	0	38	59.4	20	31.2	6	9.4
Teachers use ICT to write lesson plans	84	87.5	12	12.5	0	0	0	0	0	0	0	0	26	40.6	38	59.4
Teachers use ICT to write lesson notes	86	89.6	10	10.4	0	0	0	0	0	0	0	0	31	48.4	33	51.6
Teachers use ICT to prepare records of work	84	87.5	12	12.5	0	0	0	0	0	0	0	0	26	40.6	38	59.4
Teachers use ICT to research lesson content	49	51	47	49	0	0	0	0	0	0	30	47	30	47	4	6
Teachers use ICT to access educational materials from online data base (E.g., Websites etc.)	40	41.7	41	42.7	15	15.6	0	0	0	0	35	54.8	15	23.4	14	21.8
Teachers use ICT to prepare power point presentations	26	27.1	53	55.2	13	13.5	4	4.2	0	0	0	0	30	47	34	53
Teachers use ICT to prepare sound/audio clips for lessons	42	43.8	50	52.1	4	4.1	0	0	0	0	4	6.3	27	42.2	33	51.5
Teachers use ICT to prepare video clips for lessons	42	43.8	50	52.1	4	4.1	0	0	0	0	4	6.3	27	42.2	33	51.5
Teachers use ICT to prepare images for lessons	40	41.7	50	52.1	6	6.2	0	0	0	0	4	6.3	27	42.2	33	51.5
Teachers use ICT to prepare lesson attendance sheets	42	43.8	50	52.1	4	4.1	0	0	0	0	4	6.3	27	42.2	33	51.5

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n =64. % = 100)

The findings presented in Table 4.19 disclosed that ICT trained teachers used ICT to prepare schemes of work, with 87.5 percent of the principals of schools with ICT trained teachers highly agreeing with the statement**,** while none of the principals of schools with Non-ICT trained teachers strongly concurred with the statement. In addition, 59.4 percent of the principals of schools with Non-ICT trained teachers accepted the statement that teachers used ICT to prepare schemes of work compared

to 12.5 percent of their counterparts who also agreed with the statement. None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to prepare schemes of work compared to 31.2 percent and 9.4 percent of the principals of schools with Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

The analysis also revealed that 87.5 percent and 12.5 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to write lesson plans, while none of the principals of schools with Non-ICT trained teachers indicated similar views. To the contrary, 40.6 percent and 59.4 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to write lesson plans, while none of their counterparts disagreed or strongly disagreed with the statement. None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to write lesson notes compared to 48.4 percent and 51.6 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement respectively. 89.6 percent and 10.4 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to write lesson notes, while none of their counterparts indicated the same.

Further, the data indicated that 87.5 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that teachers used ICT to prepare records of work while none of the principals of schools with Non-ICT trained teachers strongly agreed with the statement. None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to

prepare records of work, compared to 40.6 percent and 59.4 percent of their counterparts who disagreed and strongly disagreed with the statement respectively. Similarly, 49 percent of the principals of schools with ICT trained teachers and 47 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers used ICT to research lesson content. None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to research lesson content compared to 47 percent and 4 percent of the principals of schools with Non-ICT trained teachers who had similar views respectively. None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to research lesson content compared to 51 percent of their counterparts who strongly agreed with the statement.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to access educational materials from online data base (E.g. Websites etc.) compared to 41.7 percent of the principals of schools with ICT trained teachers who strongly agreed with the statement. Similarly, 42.7 percent of the principals of schools with ICT trained teachers and 54.8 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers used ICT to access educational materials from online data base (E.g. Websites etc.). 15.6 percent of the principals of schools with ICT trained teachers disagreed with the statement that teachers used ICT to access educational materials from online data base (E.g., Websites etc.) compared to 23.4 of their counterparts had similar views. 21.8 percent of the principals of schools with Non-ICT trained teachers strongly disagreed with the statement that teachers used ICT to access educational

materials from online data base (E.g., Websites etc.), while none of their counterparts indicated the same.

The data further showed that 27.1 percent and 55.2 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to prepare PowerPoint presentations, while none of the principals of schools with Non-ICT trained teachers had similar views. To the contrary, 47 percent and 53 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to prepare PowerPoint presentations, compared to 13.5 percent and 4.2 percent of the principals of schools with ICT trained teachers who disagreed and strongly disagreed with the statement.

In addition, 43.8 percent of the principals of schools with ICT trained teachers strongly agreed with the statements that teachers used ICT to prepare sound/audio clips for lessons and prepare video clips for lessons respectively, while none of the principals of schools with Non-ICT trained teachers strongly agreed with the statements respectively. 6.3 percent of the principals of schools with Non-ICT trained teachers agreed with the statements that teachers used ICT to prepare sound/audio clips for lessons and prepare video clips for lessons respectively, compared to 52.1 percent of their counterparts who agreed with the statements respectively. However, 42.2 percent of the principals of schools with Non-ICT trained teachers disagreed with the statements that teachers used ICT to prepare sound/audio clips for lessons and prepare video clips for lessons respectively; compared to 4.1 percent of their counterparts who had similar views respectively. None of the principals of schools with ICT trained teachers strongly disagreed with the statements that teachers used

ICT to prepare sound/audio clips for lessons and prepare video clips for lessons compared to 51.5 percent of their counterparts had similar views respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statements that teachers used ICT to prepare images for lessons and prepare lesson attendance sheets respectively compared to 41.7 percent and 43.8 percent of the principals of schools with ICT trained teachers who strongly agreed with the statements respectively. In addition, 6.3 percent of the principals of schools with Non-ICT trained teachers agreed with the statements that teachers used ICT to prepare images for lessons and prepare lesson attendance sheets respectively, compared to 52.1 percent of their counterparts who indicated the same respectively. To the contrary, 42.2 percent of the principals of schools with Non-ICT trained teachers disagreed with the statements that teachers used ICT to prepare images for lessons and prepare lesson attendance sheets respectively, compared to 6.3 percent and 4.1 percent of their counterparts who disagreed with the statements respectively. In addition, 51.5 percent of the principals of schools with Non-ICT trained teachers strongly disagreed with the statements that teachers used ICT to prepare images for lessons and prepare lesson attendance sheets respectively, while none of their counterparts had similar views.

This connoted that ICT trained teachers profoundly embraced the use of ICT skills to prepare e-based learning activities which enhanced their content preparation leading to more innovative lessons due to the acquisition of pedagogical ICT training. The position is supported by research done in Italy among 80 secondary school teachers which revealed that ICT trained teachers applied technology in lesson preparation which enabled them to easily access variant educational resources and resource

formats including; audio clips, texts, images, and video/sound clips which made their subject content simpler and more innovative (Badri, 2014).

Further, the findings show that Non-ICT trained teachers lacked fundamental ICT skills to create multimedia based instructional materials like; PowerPoint presentations, sound/audio clips, video clips, and images for lessons which limited their integration of ICT in content preparation. These results supports a study conducted by Tezci (2011) which found that Non-ICT trained teachers were not sufficiently equipped with the skills to develop learning management software's which hindered the integration of technology in their content preparation; He further argued that high school teachers in Abu Dhabi region of United Arab reported lack of fundamental ICT skills as an impediment affecting their ability to use computer peripheral devices to prepare e-based learner-content interactive activities like PowerPoint presentations, audio/sound clips, video clips, images, and students' worksheets.

The analysis also implied that both ICT and Non-ICT trained teachers used ICT to prepare their professional documents and personal smartphones and tablets to research lesson content and access educational materials from online sources to enhance their content preparation. These findings concurred with the assertion that the use of ICT in pedagogy by ICT and Non-ICT trained teachers enhanced their ability to prepare schemes of work, lesson plans, lesson notes, lesson attendance sheets, records of work, and access to variant information for quality resources and innovative teaching and learning (Badri, 2014).

In addition, the teachers were also asked to indicate their level of agreement on their use of ICT skills in content preparation.

They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as contained in Table 4.20.

Table 4.20 Teachers' views on their use of ICT skills in their content preparation

	ICT trained teachers								**Non-ICT trained teachers**							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use ICT to prepare schemes of work	193	91.9	17	8.1	0	0	0	0	51	36.4	39	27.9.	30	21.4	20	14.3
Teachers use ICT to write lesson plans	193	91.9	17	8.1	0	0	0	0	0	0	0	0	56	40	84	60
Teachers use ICT to write lesson notes	179	85.2	31	14.8	0	0	0	0	0	0	13	9.3	60	42.8	67	47.9
Teachers use ICT to prepare records of work	179	85.2	31	14.8	0	0	0	0	0	0	10	7.1	63	45	67	47.9
Teachers use ICT to research lesson content	150	71.4	30	14.3	15	7.1	15	7.1	44	31.4	52	37.1	26	18.6	18	12.9
Teachers use ICT to access educational materials from online data base (Websites etc.)	116	55.2	48	22.9	26	12.4	20	9.5	40	28.6	52	37.1	30	21.4	18	12.9
Teachers use ICT to prepare power point presentations	120	57.1	50	23.8	22	10.5	18	8.6	0	0	0	0	35	25	105	75
Teachers use ICT to prepare sound/audio clips for lessons	109	51.9	63	30	18	8.6	20	9.5	0	0	10	7.1	59	42.2	71	50.7
Teachers use ICT to prepare video clips for lessons	109	51.9	63	30	18	8.6	20	9.5	0	0	10	7.1	59	42.2	71	50.7
Teachers use ICT to prepare images for lessons	109	51.9	63	30	18	8.6	20	9.5	0	0	10	7.1	59	42.2	71	50.7
Teachers use ICT to prepare lesson attendance sheets	109	51.9	63	30	18	8.6	20	9.5	0	0	10	7.1	59	42.2	71	50.7

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n =140. % = 100)

The information presented in Table 4.20 indicated that 91.9 percent and 8.1 percent of ICT trained teachers strongly agreed and agreed with the statement that they used ICT to prepare schemes of work compared to 36.4 percent and 27.9 percent of the Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. None of ICT trained teachers disagreed or strongly disagreed with the statement that they used ICT to prepare schemes of work compared to 21.4 percent and 14.3 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. None of the Non-ICT trained teachers strongly agreed and agreed with the statement that they used ICT to write lesson plans compared to 91.9 percent and 8.1 percent of ICT trained teachers who strongly agreed and agreed with the statement respectively. To the contrary, 40 percent and 60 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to write lesson plans, while none of the ICT trained teachers disagreed or strongly disagreed with the statement respectively.

The data also showed that 85.2 percent of ICT trained teachers strongly agreed with the statements that they used ICT to write lesson notes and prepare records of work respectively, while none of the Non-ICT trained teachers strongly agreed with the statements. 9.3 percent and 7.1 percent of Non-ICT trained teachers agreed with the statements that they used ICT to write lesson notes and prepare records of work respectively, compared to 14.8 percent of ICT trained teachers who agreed with the statements respectively. None of the ICT trained teachers disagreed with the statements that they used ICT to write lesson notes and prepare records of work respectively, compared to 42.8 percent and 45 percent of Non-ICT trained teachers who disagreed with the statements respectively. In addition, none of the ICT trained

teachers strongly disagreed with the statements that they used ICT to write lesson notes and prepare records of work compared to 47.9 percent of Non-ICT trained teachers who strongly disagreed with the statements respectively.

Similarly, 71.4 percent and 14.3 percent of ICT trained teachers strongly agreed and agreed with the statement that they used ICT to research lesson content respectively, while 31.4 percent and 37.1 percent of Non-ICT trained teachers had similar views respectively. To the contrary, 7.1 percent of ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to research lesson content respectively, compared to 18.6 percent and 12.9 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. The data also indicated that, 55.2 percent and 22.9 percent of ICT trained teachers strongly agreed and agreed with the statement that they used ICT to access educational materials from online data base (E.g., websites etc.) respectively, compared to 28.6 percent and 37.1 percent of Non-ICT trained teachers who had similar views respectively. However, 12.4 percent and 9.5 percent of ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to access educational materials from online data base (E.g., websites etc.) respectively; 21.4 percent and 12.9 percent of Non-ICT trained teachers had similar views respectively.

Further, the information indicated that 57.1 percent of ICT trained teachers strongly agreed with the statement that they used ICT to prepare PowerPoint presentations compared to 75 percent of Non-ICT trained teachers who strongly disagreed with the statement. None of the Non-ICT trained teachers agreed with the statement that they used ICT to prepare PowerPoint presentations compared to 23.8 of ICT trained teachers who agreed with the statement. Similarly, 10.5 percent of ICT trained

teachers and 25 percent of Non-ICT trained teachers disagreed with the statement that they used ICT to prepare PowerPoint presentations respectively.

The analysis also showed 51.9 percent and 30 percent of ICT teachers strongly agreed and agreed with the statements that they used ICT to prepare lesson attendance sheets, sound/audio clips, video clips, and images for lessons respectively; none of the Non-ICT trained teachers strongly agreed with the statements while only 7.1 percent of them agreed with the statements respectively. To the contrary, 42.2 percent and 50.7 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statements that they used ICT to prepare lesson attendance sheets, sound/audio clips, video clips, and images for lessons respectively compared to 8.6 percent and 9.5 percent of ICT trained teachers who had similar views respectively.

This connoted that ICT trained teachers had the relevant ICT training thus intensely utilized technology and ICT software to ease and heighten their content preparation for quality teaching resources and innovative pedagogy. This is in line with a comparative study conducted by Sigales (2013) in 22 secondary schools in Singapore which concluded that ICT trained teachers' application of technology in content preparation enabled the creation of multimedia based interactive and experimental instructional materials which catered for students with different learning abilities, enhanced access to a wide range of educational materials from online sources thus inclusive and quality education.

The Non-ICT trained teachers lowly employed ICT in their content preparation due to lack of formal ICT training on the use of ICT equipment in pedagogy. The low levels of ICT usage in content preparation could also be associated with inadequate ICT equipment, non-serviceable ICT equipment, huge workloads, broad curriculum, and

insufficient time to prepare technology-based lessons. This concurs with the findings that Non-ICT trained teachers were deficient of ICT skills to plan technology lessons, sort educational software and explore internet sites for teaching materials, prepare PowerPoint and images for class presentation which resulted to teacher centered classroom activities (Magbagbeola, 2012).

Both ICT and Non-ICT trained teachers embraced ICT in preparing schemes of work which is a professional document for teachers, research lesson content, and access educational materials online thus enhancing their content preparation. This reflected the position held by Lee and Tsai (2010) that ICT and Non-ICT trained teachers used word processor to prepare lesson plans, schemes of work, records of work, and compile lesson materials; further they searched different sites for educational resources leading to quality course content and heightened pedagogical practices.

The study further sought to establish the students' views on teachers' usage of ICT skills in content preparation to reinforce the principals and teachers' views. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were presented in Table 4.21.

Table 4.21 Students' views on teachers' use of ICT skills in content preparation

Responses	SA		A		D		SD		Total	
	N	%	n	%	n	%	n	%	n	%
Teachers use ICT to write lesson notes	140	36.8	93	24.5	80	21.1	67	17.6	**380**	**100**
Teachers use ICT to research lesson content	110	28.9	99	26.1	95	25	76	20	**380**	**100**
Teachers use ICT to access educational materials from online data base (E.g., Websites etc.)	102	26.8	106	27.9	90	23.7	82	21.6	**380**	**100**
Teachers use ICT to prepare power point presentations	90	23.7	95	25	92	24.2	103	27.1	**380**	**100**
Teachers use ICT to prepare sound/audio clips for lessons	97	25.5	91	24	92	24.2	100	26.3	**380**	**100**
Teachers use ICT to prepare video clips for lessons	90	23.7	95	25	92	24.2	103	27.1	**380**	**100**
Teachers use ICT to prepare images for lessons	99	26.1	90	23.7	90	23.7	101	26.5	**380**	**100**

The analysis in Table 4.21 showed that 36.8 percent and 24.5 percent of the students strongly agreed and agreed with the statement that both ICT and Non-ICT trained teachers used ICT to write lesson notes respectively, compared to 21.1 percent and 17.6 percent who disagreed and strongly disagreed with the statement respectively. In addition, 25 percent and 20 percent of the students disagreed and strongly disagreed with the statement that the teachers used ICT to research lesson content respectively, while 28.9 percent and 26.1 percent strongly agreed and agreed with the statement respectively.

Further, the information indicated that 21.6 percent of the students strongly disagreed with the statement that both ICT and Non-ICT trained teachers used ICT to access educational materials from online data base (E.g., Websites etc.) compared to 26.8 percent who strongly agreed with the statement. On the same, 27.9 percent of the students agreed with the statement that teachers used ICT to access educational

materials from online data base (E.g., Websites etc.), compared to 23.7 percent who disagreed with the statement.

Similarly, 23.7 percent and 25 percent of the students strongly agreed and agreed with the statements that teachers used ICT to prepare PowerPoint presentations and video clips for lessons respectively, compared to 24.2 percent and 27.1 percent who disagreed and strongly disagreed with the statements respectively. Likewise, 25.5 percent and 24 percent of the students strongly agreed and agreed with the statement that teachers used ICT to prepare sound/audio clips for lessons respectively compared to 24.2 percent and 26.3 percent who disagreed and strongly disagreed with the statement respectively. The analysis also showed that 26.1 percent of the students strongly agreed with the statement that both ICT and Non-ICT trained teachers used ICT to prepare images for lessons compared to 26.5 percent who strongly disagreed with the statement. Similarly, 23.7 percent of the students agreed with the statement that teachers used ICT to prepare images for lessons, while 23.7 percent of the students disagreed with the statement.

These sentiments were similar to those of the principals and teachers which signified that both ICT and Non-ICT trained teachers applied ICT skills variedly in preparing content for their teaching and learning activities. The findings concurred with a study conducted by Heick (2016) which found out that in Turkish schools both ICT and Non-ICT trained teachers were knowledgeable in basic ICT but the levels of integration in lesson preparation were very low due to huge workloads and insufficient time to use ICT tools. The teachers lowly employed ICT in preparing video clips and images to merge with the subject content, develop lesson attendance

sheets, and records of work which negatively influenced their creativity, innovation, and students' academic achievements.

4.6.2 Observation schedule on content preparation by teachers

Further the researcher carried out an observation on teachers' use of ICT skills in content preparation. The findings were as shown in Table 4.22.

Table 4.22 Observation results on teachers' use of ICT skills in content preparation

	ICT trained teachers						Non-ICT trained teachers					
Response	**ICT compliance**		**Non-ICT compliance**		**Total**		**ICT compliance**		**Non-ICT compliance**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Lesson plans	210	100	0	0	**210**	**100**	13	9.3	127	90.7	**140**	**100**
Schemes of work	210	100	0	0	**210**	**100**	125	89.3	15	10.7	**140**	**100**
Students' worksheets	210	100	0	0	**210**	**100**	115	82.1	25	17.9	**140**	**100**
Lesson notes	170	80.9	40	19.1	**210**	**100**	13	9.3	127	90.7	**140**	**100**
Hand outs	90	42.9	120	57.1	**210**	**100**	40	28.6	100	71.4	**140**	**100**
Records of work	210	100	0	0	**210**	**100**	20	14.3	120	85.7	**140**	**100**
PowerPoint slides	170	80.9	40	19.1	**210**	**100**	0	0	140	100	**140**	**100**
Video clips/Visual clips	189	90	21	10	**210**	**100**	22	15.7	118	84.3	**140**	**100**
Simulation clips	90	42.9	120	57.1	**210**	**100**	40	28.6	100	71.4	**140**	**100**
Games and Role play clips	189	90	21	10	**210**	**100**	90	64.3	50	35.7	**140**	**100**
Audio clips	180	85.7	30	14.3	**210**	**100**	12	8.6	128	91.4	**140**	**100**
Images	180	85.7	30	14.3	**210**	**100**	10	7.1	130	92.9	**140**	**100**

The data captured in Table 4.22 revealed that ICT trained teachers extensively integrated technology in their content preparation as evidenced by 100 percent of them found having ICT compliant lesson plans compared to 9.3 percent of Non-ICT trained teachers who had ICT compliant lesson plans; while 90.7 percent of Non-ICT trained teachers had non-ICT compliant lesson plans. All the ICT trained teachers had ICT compliant schemes of work compared to 89.3 percent of Non-ICT trained teachers who had ICT compliant schemes of work; only 10.7 percent of Non-ICT trained teachers were not having ICT compliant schemes of work.

In addition, 100 percent of ICT trained teachers were found having ICT compliant student's worksheets compared to 82.1 percent of Non-ICT trained teachers who had ICT compliant student's worksheets.

Further, the data indicated that 80.9 percent of ICT trained teachers had ICT compliant lesson notes compared to 9.3 percent of Non-ICT trained teachers who also had ICT compliant lesson notes. To the contrary, 90.7 percent of Non-ICT trained teachers and 19.1 percent of ICT trained teachers used lesson notes which were not ICT compliant respectively. Similarly, 57.1 percent of ICT trained teachers and 71.4 percent of Non-ICT trained teachers had non-ICT compliant handouts respectively compared to 42.9 percent of ICT trained teachers and 28.6 of Non-ICT trained teachers who had ICT compliant handouts respectively. All the ICT trained teachers had ICT compliant records of work compared to 14.3 percent of Non-ICT trained teachers who had the same; 85.7 percent of Non-ICT trained teachers were not using ICT compliant records of work. None of the Non-ICT trained teachers used PowerPoint slides compared to 80.9 percent of ICT trained teachers who used PowerPoint slides in content preparation.

The analysis also showed that 90 percent of ICT trained teachers used video/visual clips in content preparation compared to 15.7 percent of Non-ICT trained teachers who used video/visual clips; 84.3 percent of Non-ICT trained teachers were found not using video/visual clips in content preparation compared to 10 percent of ICT trained teachers. In addition, 57.1 percent of ICT trained teachers and 71.4 percent of Non-ICT trained teachers did not use simulation clips respectively compared to 42.9 percent of ICT trained teachers and 28.6 percent of Non-ICT trained teachers who were found using simulation clips in content preparation respectively.

Similarly, 90 percent of ICT trained teachers and 64.3 percent of Non-ICT trained teachers used games and role play clips in content preparation respectively. However, 35.7 percent of Non-ICT trained teachers and 10 percent of ICT trained teachers did not use games and role play clips in content preparation respectively. The observation results also indicated that 85.7 percent of ICT trained teachers used audio clips to prepare lessons, compared to 8.6 percent of Non-ICT trained teachers who used audio clips to prepare lessons respectively. To the contrary, 91.4 percent of Non-ICT trained teachers did not use audio clips in content preparation compared to 14.3 percent of ICT trained teachers. 85.7 percent of ICT trained teachers used images in lesson preparation compared to 7.1 percent of Non-ICT trained teachers; however, 92.9 percent of Non-ICT trained teachers did not use ICT compliant images in content preparation compared to14.3 percent of ICT trained teachers.

This implied that both ICT and Non-ICT trained teachers employed ICT skills in their content preparation though with variations. The ICT trained teachers greatly integrated ICT in their content preparation due to the ICT training they had acquired coupled with adequacy and serviceable ICT equipment in their schools. The Non-ICT trained teachers were not competent enough to prepare PowerPoint slides, video/visual clips, audio clips, and images and integrate them in their pedagogical practices. Non-ICT trained teachers lowly utilized ICT in preparation of lesson plans and notes which could be due to inadequacy and non-serviceable ICT equipment in the schools. This finding concurs with the views of the principals, teachers, and students.

These results support the work of Khan, Hasan and Clement (2012) who posited that Non-ICT trained teachers possessed inadequate or inappropriate ICT training to

confidently execute ICT based pedagogy in preparing and searching teaching materials for their lessons, as well as matching images, video and audio/sound clips with their subject content. The incorporation of ICT in pedagogy impacted on the modes of lesson preparation by the ICT trained teachers, enhanced their innovative skills, widened their pool of content, and increased their creativity thus improving the quality of education (Hennesy, David & Wamakote, 2010).

4.6.3 Document analysis on content preparation

In addition, the study further considered the use of document analysis guide for data triangulation purposes. The researcher sought to find out the availability of teachers' particulars for content preparation and if they included ICT related resources. The findings were as presented in Table 4.23.

Table 4.23 Availability of teachers' particulars for content preparation and inclusion of ICT related resources

	ICT trained teachers						Non-ICT trained teachers					
Response	**Yes**		**No**		**Total**		**Yes**		**No**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Lesson plans	210	100	0	0	**210**	**100**	13	9.3	127	90.7	**140**	**100**
Schemes of work	210	100	0	0	**210**	**100**	125	89.3	15	10.7	**140**	**100**
Students' worksheets	210	100	0	0	**210**	**100**	115	82.1	25	17.9	**140**	**100**
Lesson notes	190	90.5	20	9.5	**210**	**100**	13	9.3	127	90.7	**140**	**100**
Hand outs	90	42.9	120	57.1	**210**	**100**	40	28.6	100	71.4	**140**	**100**
Records of work	210	100	0	0	**210**	**100**	20	14.3	120	85.7	**140**	**100**
PowerPoint slides	170	80.9	40	19.1	**210**	**100**	0	0	140	100	**140**	**100**
Video clips/Visual clips	189	90	21	10	**210**	**100**	22	15.7	118	84.3	**140**	**100**
Simulation clips	90	42.9	120	57.1	**210**	**100**	40	28.6	100	71.4	**140**	**100**
Games and Role play clips	189	90	21	10	**210**	**100**	90	64.3	50	35.7	**140**	**100**
Audio clips	180	85.7	30	14.3	**210**	**100**	12	8.6	128	91.4	**140**	**100**
Images	180	85.7	30	14.3	**210**	**100**	10	7.1	130	92.9	**140**	**100**

The information contained in Table 4.23 indicated that 100 percent of ICT trained teachers had ICT compliant lesson plans compared to 90.7 percent of Non-ICT trained teachers who had non-ICT compliant lesson plans; 9.3 percent of Non-ICT trained teachers had ICT compliant lesson plans. In addition, 100 percent of ICT trained teachers had ICT compliant student's worksheets and schemes of work compared to 89.3 percent and 52.1 percent of Non-ICT trained teachers who had same ICT compliant documents respectively. However, 10.7 percent and 17.9 percent of Non-ICT trained teachers were found having non-ICT compliant student's worksheets and schemes of work respectively. The analysis also showed that 90.5 percent of ICT trained teachers had ICT compliant lesson notes compared to 9.3 percent of Non-ICT trained teachers who had ICT compliant lesson notes. However, 90.7 percent of Non-ICT trained teachers had lesson notes which were not ICT compliant, compared to 9.5 percent of ICT trained teachers who had lesson notes which were not ICT compliant.

To the contrary, 57.1 percent of ICT trained teachers and 71.4 percent of Non-ICT trained teachers had non-ICT compliant handouts respectively; compared to 42.9 percent of ICT trained teachers and 28.6 percent of Non-ICT trained teachers had who ICT compliant handouts respectively. None of the ICT trained teachers had non-ICT compliant records of work compared to 85.7 percent of Non-ICT trained teachers who had non-ICT compliant records of work. All the Non-ICT trained teachers were not found having PowerPoint slides compared to 80.9 percent of ICT trained teachers who had PowerPoint slides; 19.1 percent of ICT trained teachers did not have PowerPoint slides.

Further, the information revealed that, 90 percent of ICT trained teachers had video clips/visual clips compared to 15.7 percent of Non-ICT trained teachers. However,

84.3 percent of Non-ICT trained teachers did not possess video clips/visual clips compared to 10 percent of ICT trained teachers who did not have video clips/visual clips. Likewise, 57.1 percent of ICT trained teachers and 71.4 of Non-ICT trained teachers did not have simulation clips respectively compared to 42.9 percent of ICT trained teachers and 28.6 of Non-ICT trained teachers who had simulation clips for content preparation respectively. In addition, 85.7 percent of ICT trained teachers had audio clips and images for lesson preparation respectively compared to 8.6 percent and 7.1 percent of Non-ICT trained teachers who had audio clips and images respectively. However, 91.4 percent and 92.9 percent of Non-ICT trained teachers did not have audio clips and images respectively, compared to 14.3 percent of ICT trained teacher who were not found having audio clips and images respectively.

This implied that the availability of teachers' particulars for content preparation and inclusion of ICT related resources differed amongst the ICT and Non-ICT trained teachers which influenced their pedagogical practices variedly. The findings confirmed the opinions of the principals, teachers, students, and the findings of the observation schedule on ICT and Non-ICT trained teachers' usage of ICT skills and equipment for content preparation.

4.6.4 Hypothesis one testing and analysis

H_1 ICT integration does not significantly impact on content preparation by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

In order to establish whether there was a relationship between ICT integration and content preparation by teachers, a simple regression test was carried out between teachers' use of ICT skills and responses from questions on content preparation by

both ICT and Non-ICT trained teachers. A coefficient of correlation (r) was calculated which established the presence, strength, direction, and level of correlation.

The coefficient of correlation (r) was squared to obtain the coefficient of determination which explained the degree of association between ICT integration and content preparation by ICT and Non-ICT trained teachers. The results were as illustrated in Table 4.24.

Table 4.24 Simple regression model summary on the impact of ICT integration on content preparation by ICT and Non-ICT trained teachers

Model	(r)	(r^2)	Sig. (b)
ICT trained teachers	0.859	0.738	0.002
Non-ICT trained teachers	0.578	0.334	0.045

Significant at the 0.05 level (2-tailed) df= 1

(a) Constant predictor: ICT integration (b) Dependent variable: Content Preparation

The information in Table 4.24 showed that the coefficient of correlation (r) for ICT trained teachers was 0.859 implying a very strong relationship between the predictor variable (ICT integration) and teachers' content preparation. The coefficient of determination (r^2) was 0.738. The predictor level of ICT integration was close to 1 showing high strength of ICT integration in ICT trained teachers' content preparation. This implied that about 73.8% of the variation in the content preparation by ICT trained teachers was explained by ICT integration in content preparation.

Similarly for Non-ICT trained teachers the (r) value was 0.578 indicating a moderate relationship between ICT integration and teachers' content preparation. The value of (r^2) was at level 0.334 showing a weak degree of ICT integration by Non-ICT trained

teachers in content preparation. This showed that about 33.4% of the variation in the content preparation by Non-ICT trained teachers could be explained by ICT integration in content preparation.

The output in Table 4.24 illustrated that the significance level of teachers' integration of ICT in content preparation for ICT trained teachers was highly significant at *p* level 0.002 a value lower than alpha 0.05 implying that there was a high significant influence of ICT integration on teachers' content preparation by ICT trained teachers. The relationship indicated that ICT integration resulted to high levels of use of ICT skills in content preparation by ICT trained teachers. Similarly, the significance level amongst Non-ICT trained teachers was significant at *p* value 0.045 showing there was a moderate significant influence of ICT integration on their content preparation. This indicated that ICT integration impacted on Non-ICT trained teachers' content preparation though at a moderate level.

The information presented led to rejection of the study's Null hypothesis that ICT integration does not significantly impact on content preparation by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. On the contrary, the study established that ICT integration significantly impacted on content preparation by ICT trained teachers and moderately impacted on content preparation by Non-ICT trained teachers in secondary schools in Machakos County, Kenya. Hence the alternative hypothesis was accepted.

From this test, the study concluded that ICT integration significantly impacted on teachers' content preparation by ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in their content preparation was significantly higher at (p) 0.002 than their Non-ICT trained counterparts at (p) 0.045. The study concluded that

ICT trained teachers integrated ICT in their content preparation more than Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

4.7 Data analysis on the impact of ICT integration on content delivery by teachers

In relation to the impact of ICT integration on teachers' pedagogical practices; the second pedagogical practice investigated by the study was content delivery. The study sought to establish the impact of ICT integration on content delivery by teachers in secondary schools.

4.7.1 Analysis of Principals', Teachers', and Students' views on teachers' use of ICT skills in content delivery

The principals, teachers, and students were asked to respond to statements related to teachers' use of ICT skills in content delivery. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The principal's views on their level of agreement with statements regarding teachers' use of ICT skills in content delivery were as summarized in Table 4.25.

Table 4.25 Principals views on teachers' use of ICT skills in content delivery

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use power point in lesson presentation	40	41.7	20	20.8	22	22.9	14	14.6	0	0	0	0	26	40.6	38	59.4
Teachers use ICT to present simulations for fast content delivery	26	27.1	53	55.2	13	13.5.	4	4.2	0	0	0	0	26	40.6	38	59.4
Teachers use ICT to present imagery resources which ensures efficient content delivery	45	46.9	41	42.7	10	10.4	0	0	0	0	20	31.2	31	48.4	13	20.4
Teachers use ICT to present sound/audio clips in content delivery	49	51	47	49	0	0	0	0	0	0	30	47	20	31.2	14	21.8
Teachers use ICT to present video clips for efficient content delivery	49	51	47	49	0	0	0	0	0	0	21	32.8	39	60.9	4	6.3
Teachers use ICT to present animations in content delivery	40	41.7	41	42.7	15	15.6	0	0	0	0	20	31.2	30	47	14	21.8
Teachers use ICT to present graphics that enhance content delivery	26	27.1	53	55.2	13	13.5.	4	4.2	0	0	0	0	30	47	34	53
Teachers use ICT to draw diagrams to deliver content	42	43.8	50	52.1	4	4.1	0	0	0	0	4	6.3	27	42.2	33	51.5
Teachers use ICT to conduct classroom technology-based games	60	62.5	20	20.8	12	12.5	4	4.2	0	0	4	6.3	27	42.2	33	51.5
Teachers use ICT to conduct role play teaching techniques in content delivery	40	41.7	50	52	6	6.3	0	0	0	0	0	0	31	48.4	33	51.5

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n =64. % = 100)

The analysis presented in Table 4.25 indicated that 41.7 percent and 20.8 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used power point in lesson presentation respectively, while none of the principals of schools with Non-ICT trained teachers strongly agreed or agreed with the statement. To the contrary, 40.6 percent and 59.4 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used power point in lesson presentation respectively,

compared to 22.9 percent and 14.6 percent of the principals of schools with ICT trained teachers who had similar views respectively. None of the principals of schools with Non-ICT trained teachers strongly agreed or agreed with the statement that teachers used ICT to present simulations for fast content delivery compared to 27.1 percent and 55.2 percent of the principals of schools with ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 40.6 percent and 59.4 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to present simulations for fast content delivery respectively compared to 13.5 percent and 4.2 percent of their counterparts who had similar views respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to present imagery resources which ensured efficient content delivery compared to 46.9 percent of the principals of schools with ICT trained teachers who strongly agreed with the statement. Similarly, 42.7 percent of the principals of schools with ICT trained teachers and 31.2 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers used ICT to present imagery resources which ensured efficient content delivery respectively. 48.4 percent of the principals of schools with Non-ICT trained teachers disagreed with the statement teachers used ICT to present imagery resources which ensured efficient content delivery compared to 10.4 percent of their counterparts who also disagreed with the statement. None of the principals of schools with ICT trained teachers strongly disagreed with the statement that teachers used ICT to present imagery resources which ensured efficient content delivery compared to 20.4 percent of their counterparts who strongly disagreed with the statement.

The analysis also showed that 51 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that teachers used ICT to present sound/audio clips in content delivery, while none of the principals of schools with Non-ICT trained teachers indicated similar views. Similarly, 47 percent of the principals of schools with Non-ICT trained teachers and 49 percent of their counterparts agreed with the statement that teachers used ICT to present sound/audio clips in content delivery respectively. None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to present sound/audio clips in content delivery, compared to 31.2 percent and 21.8 percent of the principals of schools with Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to present video clips for efficient content delivery, compared to 51 percent of the principals of schools with ICT trained teachers who strongly agreed with the statement. Likewise, 32.8 percent of the principals of schools with Non-ICT trained teachers and 49 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to present video clips for efficient content delivery respectively. To the contrary, 60.9 percent and 6.3 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to present video clips for efficient content delivery respectively, while none of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to present animations in content delivery compared to 41.7 percent of their counterparts who strongly agreed with the statement. Similarly, 42.7 percent of the principals of schools with ICT trained teachers and 31.2 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers used ICT to present animations in content delivery respectively. To the contrary, 47 percent of the principals of schools with Non-ICT trained teachers disagreed with the statement that teachers used ICT to present animations in content delivery compared to 15.6 percent of their counterparts who disagreed with the statement. None of the principals of schools with ICT trained teachers strongly disagreed with the statement that teachers used ICT to present animations in content delivery compared to 21.8 percent of their counterparts who strongly disagreed with the statement.

Further, the data indicated that 27.1 percent and 55.2 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to present graphics that enhanced content delivery respectively; while none of the principals of schools with Non-ICT trained teachers strongly agreed or disagreed with the statements respectively. However, 47 percent and 53 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to present graphics that enhanced content delivery respectively compared to 13.5 percent and 4.2 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to draw diagrams to deliver content compared to

43.8 percent of the principals of schools with ICT trained teachers who teachers strongly agreed with the statement. 52.1 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to draw diagrams to deliver content compared to 6.3 percent of their counterparts who agreed with the statement. To the contrary, 42.2 percent and 51.5 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to draw diagrams to deliver content respectively; 4.1 percent of the principals of schools with ICT trained teachers disagreed with the statement that teachers used ICT to draw diagrams to deliver content while none strongly disagreed with the statement.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that teachers used ICT to conduct classroom technology based games compared to 62.5 percent of their counterparts who strongly agreed with the statement. In addition, 20.8 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to conduct classroom technology-based games compared to 6.3 percent of their counterparts who agreed with the statement. However, 42.2 percent and 51.5 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to conduct classroom technology based games respectively compared 12.5 percent and 4.2 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed or agreed with the statement that teachers used ICT to conduct role play teaching techniques in content delivery, compared to 41.7 percent and 52 percent of their

counterparts who strongly agreed and agreed with the statement respectively. However, 48.4 percent and 51.5 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to conduct role play teaching techniques in content delivery respectively; 6.3 percent of the principals of schools with ICT trained teachers disagreed with the statement that teachers used ICT to conduct role play teaching techniques in content delivery, while none strongly disagreed with the statement.

This implied that ICT trained teachers employed ICT skills more in content delivery compared to Non-ICT trained teachers. They utilized ICT in preparing PowerPoint slides, video and audio clips, technology-based games, and drawing diagrams which enriched their content delivery. This could be associated with the acquisition of pre-service and in-service ICT skills relevant for the development and adoption of ICTs in pedagogical practices. These findings agree with research done by Capan (2012) which established that ICT trained teachers in Canada employed technology to support their delivery styles through use of variant digital formats like; PowerPoint slides, video and audio/sound clips, simulations, graphics, drawing diagrams, and technological games thus quality demonstrations appealing to the learners.

The study established that none of the Non-ICT trained teachers strongly agreed with any of the statements regarding their use of ICT skills in content delivery. Non-ICT trained teachers were not exposed to formal ICT pedagogical training; thus, they applied their general ICT knowledge hence inhibiting their technology utilization in pedagogy and lowering the quality of content delivery. This echoes studies done by Khan, Hasan and Clement (2012) who established that Non-ICT trained secondary school teachers in Morocco didn’t embrace technology supported pedagogy such as;

multimedia applications, drawing diagrams, animating objects to clarify critical concepts, showing pictures, and playing videos hence less interesting and productive lessons lowering the quality of content delivery.

The study further sought the views of the teachers concerning their use of ICT skills in content delivery. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as contained in Table 4.26.

Table 4.26 Teachers' views on their use of ICT skills in content delivery

	ICT trained teachers								**Non-ICT trained teachers**							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use power point in lesson presentation	150	71.4	47	22.4	13	6.2	0	0	0	0	0	0	59	27.9 .	81	57.8
Teachers use ICT to present simulations for fast content delivery	110	52.4	74	35.2	17	8.1	9	4.3	0	0	0	0	68	48.6	72	51.4
Teachers use ICT to present imagery resources which ensures efficient content delivery	153	72.8	31	14.8	26	12.4	0	0	0	0	26	18.6	47	33.6	67	47.8
Teachers use ICT to present sound/audio clips in content delivery	179	85.2	31	14.8	0	0	0	0	0	0	10	7.1	63	45	67	47.9
Teachers use ICT to present video clips for efficient content delivery	136	64.8	74	35.2	0	0	0	0	0	0	26	18.6	44	31.4	70	50
Teachers use ICT to present animations in content delivery	116	55.2	48	22.9	26	12.4	20	9.5	0	0	26	18.6	47	33.6	67	47.8
Teachers use ICT to present graphics that enhance content delivery	120	57.1	50	23.8	22	10.5	18	8.6	0	0	30	21.4	45	32.1	65	46.5
Teachers use ICT to draws diagrams to deliver content	109	51.9	63	30	20	9.5	18	8.6	0	0	10	7.1	59	42.2	71	50.7
Teachers use ICT to conduct classroom technology-based games	109	51.9	63	30	18	8.6	20	9.5	0	0	10	7.1	61	43.6	69	49.3
Teachers use ICT to conduct role play teaching techniques in content delivery	109	51.9	63	30	20	9.5	18	8.6	0	0	10	7.1	59	42.2	71	50.7

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n =140. % = 100)

From the findings contained in Table 4.26 it was evident that ICT trained teachers used PowerPoint in lesson presentation with 71.4 percent strongly agreeing and 22.4 percent agreeing with the statement respectively, while none of the Non-ICT trained teachers strongly agreed or agreed with the statement. However, 27.9 percent of Non-ICT trained teachers disagreed with the statement that they used PowerPoint in lesson presentation compared to 6.2 percent of ICT trained teachers who disagreed with the statement. None of the ICT trained teachers strongly disagreed with the statement that they used PowerPoint in lesson presentation compared to 57.8 percent of Non-ICT trained teachers who strongly disagreed with the statement. None of the Non-ICT trained teachers strongly agreed or agreed with the statement that they used ICT to present simulations for fast content delivery compared to 52.4 percent and 35.2 percent of ICT trained teachers who strongly agreed and agreed with the statement respectively. To the contrary, 48.6 percent and 51.4 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to present simulations for fast content delivery respectively compared to 8.1 percent and 4.3 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

None of the Non-ICT trained teachers strongly agreed with the statement that they used ICT to present imagery resources which ensured efficient content delivery compared to 72.8 percent of ICT trained teachers who strongly agreed with the statement. Similarly, 14.8 percent of ICT trained teachers and 18.6 percent of Non-ICT trained teachers agreed with the statement that they used ICT to present imagery resources which ensured efficient content delivery respectively. However, 33.6

percent of Non-ICT trained teachers disagreed with the statement that they used ICT to present imagery resources which ensured efficient content delivery compared to 12.4 percent of ICT trained teachers who disagreed with the statement. None of the ICT trained teachers strongly disagreed with the statement that they used ICT to present imagery resources which ensured efficient content delivery compared to 47.8 percent of Non-ICT trained teachers who strongly disagreed with the statement.

The analysis indicated that 85.2 percent of ICT trained teachers strongly agreed with the statement that they used ICT to present sound/audio clips in content delivery, while none of the Non-ICT trained teachers strongly agreed with the statement. Similarly, 14.8 percent of ICT trained teachers and 7.1 percent of Non-ICT trained teachers agreed with the statement that they used ICT to present sound/audio clips in content delivery respectively. None of the ICT trained teachers disagreed or strongly disagreed with the statement that they used ICT to present sound/audio clips in content delivery compared to 45 percent and 47.9 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

None of the Non-ICT trained teachers strongly agreed with the statement that they used ICT to present video clips for efficient content delivery compared to 64.8 percent of ICT trained teachers who strongly agreed with the statement. 35.2 percent of ICT trained teachers agreed with the statement that they used ICT to present video clips for efficient content delivery compared to 18.6 percent of Non-ICT trained teachers who felt the same. None of the ICT trained teachers disagreed or strongly disagreed with the statement that they used ICT to present video clips for efficient content delivery compared to 31.4 percent and 50 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

None of the Non-ICT trained teachers strongly agreed with the statement that they used ICT to present animations in content delivery compared to 55.2 percent of ICT trained teachers who strongly agreed with the statement. Similarly, 22.9 percent of ICT trained teachers and 18.6 percent of Non-ICT trained teachers agreed with the statement that they used ICT to present animations in content delivery respectively. In addition, 33.6 percent and 47.8 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to present animations in content delivery respectively, compared to 12.4 percent and 9.5 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

The data also showed that 57.1 percent of ICT trained teachers strongly agreed with the statement that they used ICT to present graphics that enhanced content delivery, while none of the Non-ICT trained teachers strongly agreed with the statement. 21.4 of Non-ICT trained teachers agreed with the statement that they used ICT to present graphics that enhanced content delivery compared to 23.8 percent of ICT trained teachers who had similar views. However, 32.1 percent and 46.5 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to present graphics that enhanced content delivery respectively, compared to 10.5 percent and 8.6 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively

None of the Non-ICT trained teachers strongly agreed with the statements that they used ICT to draw diagrams to deliver content, and to conduct role play teaching techniques in content delivery respectively, compared to 51.9 percent of ICT trained teachers who strongly agreed with the statements respectively. 30 percent of ICT trained teachers agreed with the statements that they used ICT to draw diagrams to

deliver content, and to conduct role play teaching techniques in content delivery respectively, compared to 7.1 percent of ICT trained teachers who agreed the statements respectively. To the contrary, 42.2 percent and 50.7 percent of Non-ICT trained teachers disagreed and strongly disagreed agreed with the statements that they used ICT to draw diagrams to deliver content, and to conduct role play teaching techniques in content delivery respectively; compared to 9.5 percent and 8.6 percent of ICT trained teachers who disagreed and strongly disagreed agreed with the statements.

None of the Non-ICT trained teachers strongly agreed with the statement that they used ICT to conduct classroom technology-based games compared to 51.9 percent of ICT trained teachers who strongly agreed with the statement. 30 percent of ICT trained teachers agreed with the statement that they used ICT to conduct classroom technology-based games compared 7.1 percent of Non-ICT trained teachers who agreed with the statement. However, 43.6 percent and 49.3 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to ICT to conduct classroom technology based games respectively; compared to 8.6 percent and 9.5 percent of ICT trained teachers who disagreed and strongly disagreed with the statements.

This connoted that both ICT and Non-ICT trained teachers applied technology to present imagery resources, video clips, graphics, and present animations for efficient content delivery though with great variations. ICT trained teachers had a notable adoption of ICT in content delivery as a result of relevant training on technology use in pedagogy which elevated their delivery techniques. Non-ICT trained teachers lacked formal ICT training which inhibited their intense technology utilization in

presenting animations, graphics, simulations, preparing PowerPoint slides, video, and audio clips thus lowering the quality of content delivery. The findings mirror the study done by Turel and Johnson (2012) who found that in Europe ICT trained teachers used computers, laptops, and devices like; interactive whiteboards, LCD projectors, mobile devices, and peripheral devices in content delivery which enabled demonstration thus impacting on their content coverage efficiency and students' performance.

ICT trained teachers were able to apply the use of technology-based games, audio/sound clips, simulations, and draw diagrams for efficient and quality delivery of content. These results proved a study conducted by Lewis (2012) in Saudi Arabia on ICT integration by ICT trained teachers in science education which pointed out that, the use of simulations, pictures, graphics, video and audio clips resulted to more demonstrative teaching, question and answer approach, authentic and enquiry based learning, and deeper understanding of abstract concepts.

None of the Non-ICT trained teachers strongly agreed to any of the statements regarding their use of ICT skills in content delivery. All the Non-ICT trained teachers indicated that they did not use PowerPoint and simulations in content delivery. This was an indication that Non-ICT trained teachers were deficient of the technological expertise and competence to intensely apply ICT in their content delivery which influenced their pedagogical practices. Non-ICT trained teachers lacked ICT competence to perform complex technology-based delivery techniques like presenting graphics, simulations, animations, and preparing PowerPoint presentations which made their teaching less innovative, non-creative, and unfriendly to learners (Nkwenti, 2015).

In addition to the principals and teachers' views, the study further sought to establish the student's views on teachers' usage of ICT skills in content delivery. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were summarized in Table 4.27.

Table 4.27 Students views on teachers' use of ICT skills in content delivery

Responses	**SA**		**A**		**D**		**SD**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Teachers use power point in lesson presentation	90	23.7	80	21.1	103	27.1	107	28.1	**380**	**100**
Teachers use ICT to present simulations for fast content delivery	102	26.8	106	27.9	90	23.7	82	21.6	**380**	**100**
Teachers use ICT to present imagery resources which ensured efficient content delivery	110	28.9	76	20	95	25	99	26.1	**380**	**100**
Teachers use ICT to present sound/audio clips in content delivery	140	36.8	93	24.5	80	21.1	67	17.6	**380**	**100**
Teachers use ICT to present video clips for efficient content delivery	97	25.5	91	24	92	24.2	100	26.3	**380**	**100**
Teachers use ICT to present animations in content delivery	90	23.7	95	25	92	24.2	103	27.1	**380**	**100**
Teachers use ICT to present graphics that enhance content delivery	99	26.1	90	23.7	90	23.7	101	26.5	**380**	**100**
Teachers use ICT to draw diagrams to deliver content	90	23.7	95	25	92	24.2	103	27.1	**380**	**100**
Teachers use ICT to conduct classroom technology-based games	97	25.5	91	24	92	24.2	100	26.3	**380**	**100**
Teachers use ICT to conduct role play teaching techniques in content delivery	90	23.7	95	25	92	24.2	103	27.1	**380**	**100**

The information contained in Table 4.27 showed that 28.1 percent and 27.1 percent of the students strongly disagreed and disagreed with the statement that both ICT and Non-ICT trained teachers used power point in lesson presentation respectively compared to 23.7 percent and 21.1 percent of the students who strongly agreed and agreed with the statement respectively. 26.8 percent of the students strongly agreed with the statement that both ICT and Non-ICT trained teachers used ICT to present simulations for fast content delivery compared to 21.6 percent who strongly disagreed

with the statement. In addition, 27.9 percent of the students agreed with the statement that teachers used ICT to present simulations for fast content delivery, while 23.7 percent disagreed with the statement.

The analysis also indicated that 28.9 percent and 20 percent of the students strongly agreed and agreed with the statement that both ICT and Non-ICT trained teachers used ICT to present imagery resources which ensured efficient content delivery respectively compared to 25 percent and 26.1 percent of the students who disagreed and strongly disagreed with the statement respectively. 36.8 percent of the students strongly agreed with the statement that both ICT and Non-ICT trained teachers used ICT to present sound/audio clips in content delivery, compared to 17.6 percent who strongly disagreed with the statement. On the same, 24.5 percent of the students agreed with the statement that both ICT and Non-ICT trained teachers used ICT to present sound/audio clips in content delivery compared to 21.1 percent who disagreed with the statement.

Similarly, 25.5 percent and 24 percent of the students strongly agreed and agreed with the statements that the teachers used ICT to present video clips for efficient content delivery, and to conduct classroom technology-based games respectively, compared to 24.2 percent and 26.3 percent who disagreed and strongly disagreed with the statements respectively. Further, 24.2 percent and 27.1 percent of the students disagreed and strongly disagreed with the statements that both ICT and Non-ICT trained teachers used ICT to present animations in content delivery, draws diagrams to deliver content, and to conduct role play teaching techniques in content delivery respectively; compared to 23.7 percent and 25 percent of the students who strongly agreed and agreed with the statements respectively. ICT and Non-ICT trained teachers

used ICT to present graphics that enhanced content delivery as attested by 26.1 percent and 23.7 percent of the students who strongly agreed and agreed with the statement respectively; however, 23.7 percent and 26.5 percent of the students disagreed and strongly disagreed with the statement respectively.

This implied that ICT and Non-ICT trained teachers employed technology in content delivery variedly which enabled them to clarify and explain complex educational concepts and ideas to the students. The comprehensive usage of ICT in content delivery led to the use of technology-based games, role play, video clips, and imagery resources thus more interactive and innovative pedagogy. The variations in usage could be associated with the levels of knowhow on the application of ICT skills in pedagogy by ICT and Non-ICT trained teachers, condition of the ICT equipment, adequacy of ICT equipment, inadequate time for preparation, resistance to change, and lack of relevant ICT skills by the Non-ICT trained teachers.

The results of this study mirror studies done by Pruet, Ang and Farzin (2014) who asserted that ICT and Non-ICT trained teachers used the internet to upload recorded video demonstrations, sound clips, and images which improved their lectures. This enabled them to clarify and explain educational concepts and ideas through extensive use of description narratives thus improving students' participation and the quality of education. The use of ICT in content delivery by ICT and Non-ICT trained teachers lead to comprehensive application of classroom technology-based games, role play and imagery resources hence more innovative, collaborative, and productive teaching boosting the learners' curiosity and creativity (Ertmer & Ottenbreit-Leftwich, 2010).

4.7.2 Observation schedule on content delivery by teachers

The researcher further carried out an observation on the teachers' use of ICT skills in content delivery. The findings were as summarized in Table 4.28.

Table 4.28 Observation results on teachers' use of ICT skills in content delivery

	ICT trained teachers						Non-ICT trained teachers					
Response	**ICT compliance**		**Non-ICT compliance**		**Total**		**ICT compliance**		**Non-ICT compliance**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Soft copies of diagrams	111	52.9	99	47.1	**210**	**100**	30	21.4	110	78.6	**140**	**100**
Simulation clips	90	42.9	120	57.1	**210**	**100**	0	0	140	100	**140**	**100**
Audio/sound clips	189	90	21	10	**210**	**100**	10	7.1	130	92.9	**140**	**100**
Video clips	189	90	21	10	**210**	**100**	28	20	112	80	**140**	**100**
PowerPoint slides	170	80.9	40	19.1	**210**	**100**	0	0	140	100	**140**	**100**
Animation clips	90	42.9	120	57.1	**210**	**100**	26	18.6	114	81.4	**140**	**100**
Games and Role play clips	180	85.7	30	14.3	**210**	**100**	22	15.7	118	84.3	**140**	**100**
Graphic clips	180	85.7	30	14.3	**210**	**100**	40	28.6	100	71.4	**140**	**100**

From the observation results on teachers' use of ICT skills in content delivery captured in Table 4.28, it is evident that 52.9 percent of ICT trained teachers used soft copies of diagrams in content delivery compared to 21.4 percent of Non-ICT trained teachers who used the same. 78.6 percent of Non-ICT trained teachers were not found using soft copies of diagrams in content delivery compared to 47.1 percent of ICT trained teachers. None of the Non-ICT trained teachers used simulation clips in content delivery compared to 42.9 percent of ICT trained teachers who used simulation clips in content delivery. In addition, 90 percent of ICT trained teachers used audio/sound clips in content delivery compared to 7.1 percent of Non-ICT trained teacher who utilized audio/sound clips in content delivery. However, 92.9 percent of Non-ICT trained teachers did not use audio/sound clips in content delivery

compared to 10 percent of ICT trained teachers who were not found using the same respectively.

The results also showed that 90 percent of ICT trained teachers used video clips in content delivery compared to 20 percent of Non-ICT trained teachers who used the same respectively. To the contrary, 80 percent of Non-ICT trained teachers were not using video clips in content delivery compared to 10 percent of ICT trained teachers. None of the Non-ICT trained teachers were found utilizing PowerPoint slides in content delivery compared 80.9 percent of ICT trained teachers who used PowerPoint in content delivery respectively. 19.1 percent of ICT trained teachers did not use PowerPoint slides in content delivery. 42.9 percent of ICT trained teachers were found utilizing animation clips when delivering content respectively compared to 18.6 percent of Non-ICT trained teachers who were found using animation clips. To the contrary, 57.1 percent of ICT trained teachers and 81.4 percent of Non-ICT trained teachers did not use animation clips in content delivery respectively.

Further, 85.7 percent of ICT trained teachers used games and role play clips in content delivery compared to 15.7 percent of Non-ICT trained teachers who were found using them. However, 84.3 percent of Non-ICT trained teachers did not use games and role play clips in content delivery compared to 14.3 percent of ICT trained teachers who did not use them respectively. In addition, 85.7 percent ICT trained teachers and 28.6 percent of Non-ICT trained teachers were found using graphic clips in content delivery respectively, compared to 14.3 percent ICT trained teachers and 71.4 percent of Non-ICT trained teachers who were not found using the same respectively.

This signified that ICT trained teachers greatly employed ICT compliant equipment which enhanced their content delivery. The high usage of ICT compliant equipment

by ICT trained teachers like; PowerPoint slides, animations, video, audio, simulations, games and role play clips was as a result of the acquisition of formal ICT skills. Non-ICT trained teachers did not extensively utilize ICT compliant tools in their content delivery. The variations were due to insufficient ICT training on ICT use in pedagogy, unequal distribution of ICT equipment in the schools, and the condition of the ICT equipment. These attested to the study conducted by Wallet and Beatriz (2015) who affirmed that ICT trained teachers possessed relevant ICT training; conducted and integrated role play technique, technology-based games in content delivery, and matched video and sound/audio clips with subject content heightening their delivery techniques and quality of education compared to Non-ICT trained teachers who were deficient of formal ICT skills, lacked adequate and well-conditioned ICT equipment.

4.7.3 Document analysis on content delivery

The study further analysed the documents used by the teachers in content delivery for data triangulation purposes. The researcher sought to find out the availability of teachers' particulars for content delivery and if they included ICT related resources. The findings were as presented in Table 4.29.

Table 4.29 Availability of teachers' particulars for content delivery and inclusion of ICT related resources

	ICT trained teachers						Non-ICT trained teachers					
Response	**Yes**		**No**		**Total**		**Yes**		**No**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
PowerPoint slides	170	80.9	40	19.1	**210**	**100**	0	0	140	100	**140**	**100**
Video/Visual clips	189	90	21	10	**210**	**100**	28	20	112	80	**140**	**100**
Simulation clips	90	42.9	120	57.1	**210**	**100**	0	0	140	100	**140**	**100**
Games and Role play clips	189	90	21	10	**210**	**100**	22	15.7	118	84.3	**140**	**100**
Audio clips	180	85.7	30	14.3	**210**	**100**	10	7.1	130	92.9	**140**	**100**
Images	180	85.7	30	14.3	**210**	**100**	50	35.7	90	64.3	**140**	**100**
Soft copies of diagrams	111	52.9	99	47.1	**210**	**100**	30	21.4	110	78.6	**140**	**100**
Animation clips	90	42.9	120	57.1	**210**	**100**	26	18.6	114	81.4	**140**	**100**
Graphic clips	180	85.7	30	14.3	**210**	**100**	40	28.6	100	71.4	**140**	**100**

The information contained in Table 4.29 indicated that all the Non-ICT trained teachers did not have PowerPoint slides for content delivery compared to 80.9 percent of ICT trained teachers who had PowerPoint slides; 19.1 percent of ICT trained teachers did not have PowerPoint slides. In addition, 90 percent of ICT trained teachers had video/visual clips, and games and role play clips respectively, compared to 20 percent and 15.7 percent of Non-ICT trained teachers who also had video/visual clips, and games and role play clips for content delivery respectively. However, 80 percent and 84.3 percent of Non-ICT trained teachers did not possess video/visual clips and games and role play clips respectively, compared to 10 percent of ICT trained teachers who did not possess the particulars respectively.

None of the Non-ICT trained teachers had simulation clips for content delivery compared to 57.1 percent of ICT trained teachers who did not have simulation clips. However, 42.9 percent of ICT trained teachers had simulation clips for content delivery. In addition, 85.7 percent of ICT trained teachers had audio clips and images

for delivering content respectively compared to 7.1 percent and 35.7 percent of Non-ICT trained teachers who had audio clips and images respectively. To the contrary, 92.9 percent and 64.3 percent of Non-ICT trained teachers did not have audio clips and images respectively, compared to 14.3 percent of ICT trained teacher who were not found having the same particulars respectively.

The analysis showed that 52.9 percent of ICT trained teachers had soft copies of diagrams for content delivery compared to 21.4 percent of Non-ICT trained teachers who had soft copies of diagrams for content delivery. However, 47.1 percent of ICT trained teachers and 78.6 of Non-ICT trained teachers did not have soft copies of diagrams respectively. Similarly, 57.1 percent of ICT trained teachers did not have animation clips compared to 81.4 percent of Non-ICT trained teachers who did not have animation clips respectively. 42.9 percent of ICT trained teachers had animation clips compared to 18.6 of Non-ICT trained teachers who had animation clips respectively. 85.7 percent of ICT trained teachers and 28.6 of Non-ICT trained teachers had graphic clips for content delivery respectively compared to 14.3 percent of ICT trained teachers and 71.4 of Non-ICT trained teachers who did not have graphic clips for content delivery respectively.

This implied that the availability of teachers' particulars for content delivery and inclusion of ICT related resources differed amongst the ICT and Non-ICT trained teachers which influenced their pedagogical practices variedly. ICT trained were found having more ICT compliant particulars for use in content delivery compared to Non-ICT trained teachers. This confirmed the findings from the principals, teachers, students, and observation results on ICT and Non-ICT trained teachers' usage of ICT skills in content delivery.

4.7.4 Hypothesis two testing and analysis

H_2 ICT integration does not significantly impact on content delivery by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

In a bid to establish the relationship between ICT integration and teachers' content delivery, a simple regression test was carried out between teachers' use of ICT skills and responses from questions on content delivery by both ICT and Non-ICT trained teachers. Correlation level (r) was calculated to determine the presence and level of correlation. The coefficient of correlation (r) was squared to obtain the coefficient of determination which was used to determine the degree of association between ICT integration and content delivery by ICT and Non-ICT trained teachers. The results were as illustrated in Table 4.30.

Table 4.30 Simple regression model summary on the impact of ICT integration on content delivery by ICT and Non-ICT trained teachers

Model	(r)	(r^2)	Sig. (b)
ICT trained teachers	0.851	0.724	0.003
Non-ICT trained teachers	0.568	0.323	0.047

Significant at the 0.05 level (2-tailed) df= 1

(**a) Constant predictor: ICT integration (b) Dependent variable: Content delivery**

The analysis in Table 4.30 indicated that the coefficient of correlation (r) for ICT trained teachers was 0.851 implying a very strong relationship between ICT integration and teachers' content delivery. The coefficient of determination (r^2) was 0.724 indicating a very strong predictor level of ICT integration in content delivery among ICT trained teachers. This implied that about 72.4% of the variation in teachers' content delivery was explained by ICT integration.

Similarly (r) value for Non-ICT trained teachers indicated moderate relationship of 0.568 between ICT integration and teachers' content delivery. The value of (r^2) predictor level was at 0.323 indicating a moderate level of ICT integration in content delivery by Non-ICT trained teachers. This indicated that about 32.3% of Non-ICT trained teachers integrated ICT in their content delivery.

Further the information presented in Table 4.30 demonstrated that the significance levels of teachers' integration of ICT in content delivery for ICT trained teachers was extremely significant at *p* level 0.003 a value lower than alpha 0.05. This showed that there was a high significant influence of ICT integration on teachers' content delivery by ICT trained teachers. The significance demonstrated that ICT integration resulted to high levels of use of ICT in content delivery by ICT trained teachers.

Similarly, the significance levels for Non-ICT trained teachers were significant at *p* value 0.047 implying there was moderate significant influence of ICT integration on the teachers' content delivery by Non-ICT trained teachers. This was an indication that ICT integration averagely influenced Non-ICT trained teachers' content delivery.

The information analyzed in Table 4.30 led to rejection of the study's Null hypothesis that ICT integration does not significantly impact on content delivery by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. On the contrary, the study established that ICT integration significantly impacted on content delivery by ICT trained teachers and moderately impacted on content delivery by Non-ICT trained teachers in secondary schools in Machakos County, Kenya. Therefore, the alternative hypothesis was adopted.

From these findings, the study concluded that ICT integration significantly impacted on teachers' content delivery by ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in their content delivery was significantly higher at (p) 0.003 than for Non-ICT trained teachers at (p) 0.047. The study concluded that ICT trained teachers integrated ICT in their content delivery greatly than Non-ICT trained teachers in secondary schools in Machakos County, Kenya

4.8 Data analysis on the impact of ICT integration on content assessment by teachers

The third teachers' pedagogical practice investigated by the study was content assessment. The study sought to determine the impact of ICT integration on content assessment by teachers in secondary schools. Peeraer and Petegem (2012) observed that ICT enhanced assessment helped instructors to improve their pedagogy and set more comprehensive modes and directions of teaching; ICT impacted on the formative and summative assessment techniques used by the teachers. To this end the study explored the impact of ICT integration on teachers' content assessment.

4.8.1 Analysis of Principals', Teachers', and Students' views on teachers' use of ICT skills in content assessment

In this section the study sought to establish the views of the principals, teachers, and students on their levels of agreement with statements regarding teachers' usage of ICT skills in content assessment. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The views of the principals in relation to teachers' usage of ICT skills in content assessment were as summarized in Table 4.31.

Table 4.31 Principal's views on teachers' use of ICT skills in content assessment

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use ICT to prepare continuous assessment tests (CATs) for students	72	75	24	25	0	0	0	0	38	59.4	26	40.6	0	0	0	0
Teachers use ICT to prepare class assignments	26	27.1	53	55.2	17	17.7	0	0	10	15.6	20	31.2	26	40.6	8	12.6
Teachers use ICT to set examinations	70	73	26	27	0	0	0	0	44	68.8	20	31.2	0	0	0	0
Teachers use ICT to write Computer Studies examinations	66	68.8	30	31.2	0	0	0	0	34	53	30	47	0	0	0	0
Teachers use ICT to compile examination performance reports for students using spreadsheets	49	51	47	49	0	0	0	0	4	6.3	19	29.7	20	31.2	21	32.8
Teachers use ICT to provide online feedback on students' performance in examinations	55	57.3	41	42.7	0	0	0	0	20	31.2	30	47	14	21.8	0	0
Teachers use ICT to track cumulative students' performance in examinations	53	55.2	26	27.1	17	17.7	0	0	10	15.6	12	18.8	20	31.2	22	34.4
Teachers use ICT to check plagiarism in students' essays	0	0	0	0	50	52.1	46	47.9	0	0	0	0	27	42.2	37	57.8
Teachers use ICT to grade students' performance	60	62.5	36	37.5	0	0	0	0	14	21.8	18	28.2	12	18.8	20	31.2

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n =64. % = 100)

The analysis presented in Table 4.31 revealed that all ICT and Non-ICT trained teachers employed ICT to prepare continuous assessment tests (CATs) for students, with 75 percent and 25 percent of the principals of schools with ICT trained teachers strongly agreeing and agreeing with the statement respectively; similarly, 59.4 percent and 40.6 percent of the principals of schools with Non-ICT trained teachers strongly agreed and agreed with the statement respectively. In addition, 27.1 percent and 55.2 percent of the principals of schools with ICT trained teachers strongly agreed and

agreed with the statement that teachers used ICT to prepare class assignments respectively, compared to 15.6 percent and 31.2 percent of the principals of schools with Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 40.6 percent of the principals of schools with Non-ICT trained teachers disagreed with the statement that teachers used ICT to prepare class assignments compared to 17.7 percent of their counterparts who had similar views. None of the principals of schools with ICT trained teachers strongly disagreed with the statement that teachers used ICT to prepare class assignments compared to 12.6 percent of their counterparts who strongly disagreed with the statement.

None of the principals of either category disagreed or strongly disagreed with the statement that teachers used ICT to set examinations. On the contrary, 73 percent and 27 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to set examinations respectively, compared to 68.8 percent and 31.2 percent of the principals of schools with Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. Both ICT and Non-ICT trained teachers used ICT to write Computer Studies examinations with none of the principals of either category disagreeing and strongly disagreeing with the statement respectively. It was evident that, 68.8 percent and 31.2 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to write Computer Studies examinations respectively, compared to 53 percent and 47 percent of their counterparts who strongly agreed and agreed with the statement respectively.

None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to compile examination

performance reports for students using spreadsheets; while 6.3 percent of the principals of schools with Non-ICT trained teachers disagreed with the statement and none strongly disagreed with the statement respectively. On the other hand, 51 percent and 49 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to compile examination performance reports for students using spreadsheets; compared to 32.8 percent and 60.9 percent of their counterparts who strongly agreed and agreed with the statement respectively.

The information further indicated that 57.3 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations compared to 31.2 percent of the principals of schools with Non-ICT trained teachers who strongly agreed with the statement. Similarly, 42.7 percent of the principals of schools with ICT trained teachers of the principals of schools with ICT trained teachers and 47 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations respectively. Withal, 21.8 percent of the principals of schools with Non-ICT trained teachers disagreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations, while none of their counterparts disagreed with the statement. Similarly, none of the principals of either category strongly disagreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations.

Further, 55.2 percent and 27.1 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to track

cumulative students' performance in examinations respectively, compared to 15.6 percent and 18.8 percent of their counterparts who strongly agreed and agreed with the statement respectively. On the other hand, 31.2 percent of the principals of schools with Non-ICT trained teachers disagreed with the statement that teachers used ICT to track cumulative students' performance in examinations compared to 17.7 percent of their counterparts who disagreed with the statement. None of the principals of schools with ICT trained teachers strongly disagreed with the statement that teachers used ICT to track cumulative students' performance in examinations compared to 34.4 percent of their counterparts who strongly disagreed with the statement.

None of the principals of either category strongly agreed or agreed with the statement that teachers used ICT to check plagiarism in students' essays. To the contrary, 52.1 percent and 47.9 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to check plagiarism in students' essays respectively. Likewise, 42.2 percent and 57.8 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement respectively. All the principals of schools with both ICT and Non-ICT trained teachers strongly disagreed with the statement that teachers used ICT to grade students' performance. None of the of the principals of schools with ICT trained teachers disagreed with the statement that teachers used ICT to grade students' performance compared to 21.8 percent of their counterparts who disagreed with the statement. However, 62.5 percent and 37.5 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to grade students' performance respectively compared to 34.2 percent and 44

percent of the principals of schools with Non-ICT trained teachers who strongly agreed and agreed with the statement respectively.

The results implied that both ICT and Non-ICT trained teacher's utilized ICT to prepare continuous assessment tests (CATs), set examinations, and write Computer Studies examinations. The analysis also demonstrated that both ICT and Non-ICT trained teacher's intensely utilized technology in assessing, evaluating, and measuring the students learning outcomes leading to improved content assessment. In addition, the results meant that many secondary school administrators had acquired programs for compiling and grading students' examination results which upgraded teachers' content assessment.

The data also indicated that all the secondary schools lacked the ICT equipment for detecting plagiarism in students' essays which could be associated to inadequacy of finances. The ICT trained teachers possessed the technological expertise to grade students' performance, track cumulative performance, and provide online feedback on students' performance in examinations compared to Non-ICT trained teachers which influenced their levels of content assessment variedly.

These testifies the study conducted by Tsai and Chai (2012) who argued that ICT trained teachers applied their technology expertise to access a wider pool of examinations and experiments online thus upgrading their preparation of assignments, internal examinations, continuous assessment tests (CATs), class presentations, and essays administered to the learners; this increased their frequency of assessment, and enabled access to solutions for difficult and complex tasks. Non-ICT trained teachers were deficient of the required expertise to apply ICT in grading students' performance, providing online feedback on students' performance, compiling and

tracking cumulative students' examination reports thus limiting their assessment intervals, and achievement of the outlined learner outcomes (Tsai & Chai, 2012).

In addition to the principal's views, the study further sought the views of the teachers on their extent of agreement with statements concerning their use of ICT skills in content assessment. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as indicated in Table 4.32.

Table 4.32 Teachers views on their use of ICT skills in content assessment

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use ICT to prepare continuous assessment tests (CATs) for students	150	71.4	60	28.6	0	0	0	0	81	57.9	59	42.1	0	0	0	0
Teachers use ICT to prepare class assignments	78	37.1	74	35.2	27	12.9	31	14.8	20	14.3	30	21.4	48	34.3	42	30
Teachers use ICT to set examinations	153	72.9	57	27.1	0	0	0	0	93	66.4	47	33.6	0	0	0	0
Teachers use ICT to write Computer Studies examinations	179	85.2	31	14.8	0	0	0	0	77	55	63	45	0	0	0	0
Teachers use ICT to compile examination performance reports for students using spreadsheets	136	64.8	74	35.2	0	0	0	0	16	11.4	34	24.3	40	28.6	50	35.7
Teachers use ICT to provide online feedback on students' performance in examinations	116	55.2	74	35.3	20	9.5	0	0	67	47.8	47	33.6	26	18.6	0	0
Teachers use ICT to track cumulative students' performance in examinations	106	50.5	104	49.5	0	0	0	0	15	10.7	35	25	40	28.6	50	35.7
Teachers use ICT to check plagiarism in students' essays	0	0	0	0	106	50.5	104	49.5	0	0	0	0	71	50.7	69	49.3
Teachers use ICT to grade students' performance	127	60.5	83	39.5	0	0	0	0	20	14.3	49	35	20	14.3	51	36.4

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n =140. % = 100)

From the findings presented in Table 4.32 it is apparent that the opinions of the teachers concurred with one's of the principals that teachers used ICT to prepare continuous assessment tests (CATs) for students, with 71.4 percent and 28.6 percent of ICT trained teachers strongly concurring with the statement compared to 57.9 percent and 42.1 percent of Non-ICT trained teachers who had similar views respectively. In addition, 37.1 percent and 35.2 percent of ICT trained teachers

strongly agreed and agreed with the statement that teachers used ICT to prepare class assignments respectively compared to 14.3 percent and 21.4 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. To the contrary, 12.9 percent and 14.8 percent of ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to prepare class assignments respectively, compared to 34.3 percent and 30 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

Similarly, none of the ICT and Non-ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to set examinations. Withal, 72.9 percent and 27.1 percent of ICT trained teachers strongly agreed and agreed with the statement that they used ICT to set examinations respectively, compared to 66.4 percent and 33.6 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. All ICT and Non-ICT trained teachers indicated that teachers used ICT to write Computer Studies examinations; with 85.2 percent and 14.8 percent of ICT trained teachers strongly agreeing and agreeing with the statement respectively, compared to 55 percent and 45 percent of Non-ICT trained teachers who had similar views respectively.

None of the ICT and Non-ICT trained teachers strongly disagreed with the statement that teachers applied ICT to compile examination performance reports for students using spreadsheets. In addition, neither of the ICT trained teachers disagreed with the statement that teachers used ICT to compile examination performance reports for students using spreadsheets, compared to 11.4 percent of Non-ICT trained teachers who disagreed with the statement. However, 64.8 percent and 35.2 percent of ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT

to compile examination performance reports for students using spreadsheets respectively, compared to 57.2 percent and 31.4 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively.

None of the ICT and Non-ICT trained teachers strongly disagreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations. 18.6 percent of Non-ICT trained teachers disagreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations compared to 9.5 percent of ICT trained teachers who had similar views. Similarly, 35.3 percent of ICT trained teachers and 33.6 percent of Non-ICT trained teachers agreed with the statement that teachers used ICT to provide online feedback on students' performance in examinations respectively. On the same statement, 55.2 percent of ICT trained teachers strongly agreed that teachers used ICT to provide online feedback on students' performance in examinations compared to 47.8 percent of Non-ICT trained teachers who felt the same.

None of the ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to track cumulative students' performance in examinations, compared to 10.7 percent and 7.1 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. Nevertheless, 50.5 percent and 49.5 percent of ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to track cumulative students' performance in examinations respectively, compared to 42.9 percent and 39.3 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively.

None of the ICT and Non-ICT trained teachers strongly agreed or agreed with the statement that teachers used ICT to check plagiarism in students' essays.

To the contrary, 50.5 percent and 49.5 percent of ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to check plagiarism in students' essays respectively, compared to 50.7 percent and 49.3 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. In addition, 60.5 percent and 39.5 percent of ICT trained teachers strongly agreed and agreed with the statement that teachers used ICT to grade students' performance in examinations respectively, compared to 14.3 percent and 35 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. None of the ICT trained teachers disagreed or strongly disagreed with the statement that teachers used ICT to grade students' performance in examinations compared to 14.3 percent and 36.4 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

This signified that both ICT and Non-ICT trained teachers highly utilized technology in preparing continuous assessment tests (CATs), setting examinations, and writing of Computer Studies examinations resulting to increased frequency of assessment, timely and authentic feedback which enhanced their pedagogical practices. These findings agreed with studies done by Farrell and Rushby (2016) who postulated that assessment is an integral part of the teaching and learning process; the application of ICT in content assessment by ICT and Non-ICT trained teachers impacted on their preparation of class assignments, continuous assessment tests (CATs), examinations, and writing of Computer Studies examinations leading to the achievement of the desired student learning outcomes (SLO).

Non-ICT trained teachers possessed the basic ICT skills relevant for integrating technology in content assessment though they lacked formal ICT pedagogical training

hence unable to utilize ICT to compile examination performance reports for students using spreadsheets, track cumulative students' performance in examinations, and grade students' performance which influenced their pedagogy. This is in line with a study done by Ifenthaler and Schweinbenz (2013) who posited that Non-ICT trained teachers lacked the technological skills to track cumulative students' performance, grade students using technology and detect plagiarism in students' essays thus influencing their quality and frequency of assessment.

ICT and Non-ICT trained teachers did not intensely use ICT to prepare class assignments. This signified that both ICT and Non-ICT trained teachers regularly gave the students assignments found in the subject course books for revision purposes. Both ICT and Non-ICT trained teachers disagreed with the statement that they used ICT to check plagiarism in students' essays. This could be associated with lack of the relevant ICT equipment in the schools due to inadequacy of finances. This concurred with findings by Magbagbeola (2012) who found that ICT trained teachers were found to employ ICT in assessing the learners' performance hence boosting the rate and interval of examination; rather all teachers were unable to detect plagiarism in essays and track students' performance due to unavailability of some digital programs and devices.

In addition, the study sought the views of the students relating to teachers' use of ICT skills in their content assessment. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. Their views were as indicated in Table 4.33.

Table 4.33 Student's views on teachers' use of ICT skills in content assessment

Responses	SA		A		D		SD		Total	
	n	%	n	%	n	%	n	%	n	%
Teachers use ICT to prepare continuous assessment tests (CATs) for students	220	57.9	160	42.1	0	0	0	0	**380**	**100**
Teachers use ICT to prepare class assignments	120	31.6	109	28.7	95	25	56	14.7	**380**	**100**
Teachers use ICT to set examinations	230	60.5	150	39.5	0	0	0	0	**380**	**100**
Teachers use ICT to write Computer Studies examinations	193	50.8	187	49.2	0	0	0	0	**380**	**100**
Teachers use ICT to compile examination performance reports for students using spreadsheets	177	46.6	163	42.9	40	10.5	0	0	**380**	**100**
Teachers use ICT to provide online feedback on students' performance in examinations	123	32.4	105	27.6	98	25.8	54	14.2	**380**	**100**
Teachers use ICT to track cumulative students' performance in examinations	111	29.2	99	26.1	90	23.7	80	21	**380**	**100**
Teachers use ICT to check plagiarism in students' essays	0	0	0	0	185	48.7	195	51.3	**380**	**100**
Teachers use ICT to grade students' performance	169	44.5	155	40.8	56	14.7	0	0	**380**	**100**

According to the data contained in Table 4.33, the views of the students matched with those of the principals and teachers on teachers' use of ICT skills in content assessment. All the students felt that both ICT and Non-ICT trained teachers utilized ICT to prepare continuous assessment tests (CATs) for students with 57.9 percent strongly agreeing and 28.7 percent agreeing with the statement respectively. To the contrary, 25 percent and 14.7 percent of the students disagreed and strongly disagreed with the statement that ICT and Non-ICT trained teachers used ICT to prepare class assignments respectively; while 31.6 percent and 28.7 percent of the students strongly agreed and agreed with the statement that the teachers used ICT to prepare class assignments respectively.

The students confirmed that ICT and Non-ICT trained teachers used ICT to set examinations; 60.5 percent and 39.5 percent strongly agreed and agreed with the

statement respectively. Similarly, all ICT and Non-ICT trained teachers used ICT to write Computer Studies examinations, with 50.8 percent and 49.2 percent of the students strongly agreeing and agreeing with the statement respectively. None of the students strongly disagreed with the statement that ICT and Non-ICT trained teachers used ICT to compile examination performance reports for students using spreadsheets, while 10.5 percent disagreed with the statement. Consequently, 46.6 percent and 42.9 percent of the students strongly agreed and agreed with the statement that ICT and Non-ICT trained teachers used ICT to compile examination performance reports for students using spreadsheets respectively.

The analysis also indicated that 32.4 percent and 27.6 percent of the students strongly agreed and agreed with the statement that ICT and Non-ICT trained teachers used ICT to provide online feedback on students' performance in examinations respectively; compared to 25.8 percent and 14.2 percent of the students who disagreed and strongly disagreed with the statement respectively. In addition, 29.2 percent and 26.1 percent of the students strongly agreed and agreed with the statement that ICT and Non-ICT trained teachers used ICT to track cumulative students' performance in examinations respectively; compared to 23.7 percent and 21 percent of the students who disagreed and strongly disagreed with the statement respectively.

None of the students strongly agreed or agreed with the statement that ICT and Non-ICT trained teachers used ICT to check plagiarism in students' essays. To the contrary, 48.7 percent and 51.3 percent of the students disagreed and strongly disagreed with the statement respectively. None of the students strongly disagreed with the statement that ICT and Non-ICT trained teachers used ICT to grade students' performance, while 14.7 percent disagreed with the statement. However, 44.5 percent

and 40.8 percent of the students strongly agreed and agreed with the statement that ICT and Non-ICT trained teachers used ICT to grade students' performance respectively.

This was an indication that both ICT and Non-ICT trained teachers used technology widely in content assessment due to the adequacy of computers/laptops for typing exams and continuous assessment tests (CATs). The school administrators also ensured that the computers/laptops and other relevant ICT equipment were serviceable during the examination period to ensure that students were offered ICT compliant examination. Most of the schools had acquired the relevant programs for compiling and grading students' examination results which upgraded their content assessment. These collaborates with the study done by Howard (2013) who asserted that both ICT and Non-ICT trained teachers used computer peripherals to formulate their assessment tasks, record and analyze students' responses, and provide examination performance feedback thus able to assess whether lesson objectives had been achieved and assess a wide range of skills which elevated the students' motivation to learn.

4.8.2 Observation schedule on content assessment by teachers

Further the researcher conducted an observation schedule on teachers' use of ICT skills in content assessment. The results were as contained in Table 4.34.

Table 4.34 Observation results on teachers' use of ICT skills in content assessment

	ICT trained teachers						Non-ICT trained teachers					
Response	**ICT compliance**		**Non-ICT compliance**		**Total**		**ICT compliance**		**Non-ICT compliance**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Score spreadsheets	210	100	0	0	**210**	**100**	35	25	105	75	**140**	**100**
Typed examinations	210	100	0	0	**210**	**100**	140	100	0	0	**140**	**100**
Typed assignments	160	76.2	50	23.8	**210**	**100**	60	42.9	80	57.1	**140**	**100**
Typed continuous assessment tests (CATs)	210	100	0	0	**210**	**100**	140	100	0	0	**140**	**100**
Students progressive record reports	210	100	0	0	**210**	**100**	35	25	105	75	**140**	**100**
Analyzed results	210	100	0	0	**210**	**100**	35	25	105	75	**140**	**100**

From the observation results presented in Table 4.34 on teachers' usage of ICT skills in content assessment, it was found that 100 percent of both ICT and Non-ICT trained teachers administered ICT compliant examinations and continuous assessment tests (CATs) respectively. All ICT trained teachers used ICT compliant score spreadsheets compared to 25 percent of Non-ICT trained teachers who used ICT compliant score spreadsheets; However, 75 percent of Non-ICT trained teachers were not found using ICT compliant score spreadsheets. In addition, 76.2 percent of ICT trained teachers administered typed assignments to students compared to 42.9 percent of Non-ICT trained teachers who also administered typed assignments to students. To the contrary, 23.8 percent of ICT trained teachers did not administer typed assignments to students compared to 57.1 percent of Non-ICT trained teachers who administered non-ICT compliant assignments to students.

All ICT trained teachers had ICT compliant students' progressive record reports and analyzed results respectively compared to 25 percent of Non-ICT trained teachers who had ICT compliant students' progressive record reports and analyzed results

respectively. Withal, 75 percent of Non-ICT trained teachers did not have ICT compliant students' progressive record reports and analyzed results respectively.

This was an indication that both ICT and Non-ICT trained teachers utilized digital devices in their content assessment which led to efficient and effective pedagogy. It was also established that ICT and Non-ICT trained teachers intensely employed ICT compliant tools in assessing the academic achievement levels of their students though with variations. Both ICT and Non-ICT trained teachers were found giving the students Non-ICT compliant assignments. This was due to the revision questions and exercises found in the students' course books. These corroborates with the study done by Farrell and Rushby (2016) who found that technology use in assessment by ICT and Non-ICT trained teachers facilitated the application of variant Classroom Assessment Techniques (CATs) easy to use and interpret, thus enabling provision of short-term feedback and wealth information about students' thinking, enriching the efficacy of examination, and improving students' performance.

4.8.3 Document analysis on content assessment

The study further used document analysis guide for data triangulation purposes. The researcher sought to find out the availability of teachers' particulars for content assessment and if they included ICT related resources. The findings were as presented in Table 4.35.

Table 4.35 Availability of teachers' particulars for content assessment and inclusion of ICT related resources

	ICT trained teachers						Non-ICT trained teachers					
Response	**Yes**		**No**		**Total**		**Yes**		**No**		**Total**	
	N	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Score spreadsheets	210	100	0	0	**210**	**100**	35	25	105	75	**140**	**100**
Typed examinations	210	100	0	0	**210**	**100**	140	100	0	0	**140**	**100**
Typed assignments	160	76.2	50	23.8	**210**	**100**	60	42.9	80	57.1	**140**	**100**
Typed continuous assessment tests (CATs)	210	100	0	0	**210**	**100**	140	100	0	0	**140**	**100**
Students progressive record reports	210	100	0	0	**210**	**100**	35	25	105	75	**140**	**100**
Analyzed results	210	100	0	0	**210**	**100**	35	25	105	75	**140**	**100**

The information contained in Table 4.35 indicated that 100 percent of the ICT and Non-ICT trained teachers had typed examinations and typed continuous assessment tests (CATs) respectively. All the ICT trained teachers were found having ICT compliant score spreadsheets compared to 25 percent of Non-ICT trained teachers who were found having ICT compliant score spreadsheets. However, 75 percent of Non-ICT trained teachers did not have ICT compliant score spreadsheets. In addition, 76.2 percent of ICT trained teachers had typed assignments compared to 42.9 percent of Non-ICT trained teachers who also had typed assignments respectively. On the other hand, 23.8 percent of ICT trained teachers and 57.1 percent of Non-ICT trained teachers did not administer typed assignments to students respectively. All the ICT trained teachers had ICT compliant students' progressive record reports and analyzed results respectively compared to 25 percent of Non-ICT trained teachers who had the same particulars respectively. To the contrary, 75 percent of Non-ICT trained teachers did not have ICT compliant students' progressive record reports and analyzed results respectively.

This implied that the availability of teachers' particulars for content assessment and inclusion of ICT related resources differed amongst the ICT and Non-ICT trained teachers which influenced their pedagogical practices, with ICT trained teachers recording higher percentages of utilization of ICT compliant content assessment particulars compared to Non-ICT trained teachers. The findings confirmed the views of the principals, teachers, students, and the observation results on ICT and Non-ICT trained teachers' usage of ICT skills and equipment in content assessment.

4.8.4 Hypothesis three testing and analysis

H_3 ICT integration does not significantly impact on content assessment by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

The relationship between ICT integration and content assessment by ICT trained and Non-ICT trained teachers was tested through a simple regression between teachers' use of ICT skills and responses from questions on content assessment for both ICT and Non-ICT trained teachers. A correlation coefficient level (r) was calculated in order to establish the presence and level of correlation. The coefficient of correlation (r) was squared to obtain the coefficient of determination. The (r^2) was used to determine the degree of association between ICT integration and content assessment by ICT and Non-ICT trained teachers. The results were presented in Table 4.36.

Table 4.36 Simple regression model summary on the impact of ICT integration on content assessment by ICT and Non-ICT trained teachers

Model	(r)	(r^2)	Sig. (b)
ICT trained teachers	0.914	0.835	0.001
Non-ICT trained teachers	0.598	0.358	0.004

Significant at the 0.05 level (2-tailed) df= 1

(a) Constant predictor: ICT integration (b) Dependent variable: Content Assessment

The analysis presented in Table 4.36 indicated that the coefficient of relation (r) for ICT trained teachers was at level 0.914 showing a very strong relationship between teachers' ICT integration and content assessment. The coefficient of determination (r^2) was 0.835 showing a very strong predictor level of ICT integration in teachers' content assessment among ICT trained teachers. This output implied that about 83.5% of the variation in ICT trained teachers' content assessment was explained by ICT integration.

The (r) value for Non-ICT trained teachers posted a moderate relationship of 0.598 between teachers' ICT integration and content assessment. The ICT integration predictor level was 0.358. This showed a weak level of about 35.8% of Non-ICT trained teachers whose content assessment was explained by ICT integration.

In addition, the data contained in Table 4.36 indicated that the level of significance of ICT integration in content assessment by ICT trained teachers was highly significant at *p* level 0.001. This implied that there was a remarkably high significant level of ICT integration on content assessment of ICT trained teachers. The significance indicated that ICT integration resulted to high levels of use of ICT skills in content assessment by ICT trained teachers.

Further the analysis indicated that the significance level for Non-ICT trained teachers was found to be significant at *p* value 0.04, depicting that there was a fairly important effect of ICT integration on teachers' content assessment. This demonstrated that ICT integration influenced Non-ICT trained teachers' content assessment though at moderate levels.

The analysis in Table 4.36 drove to rejection of the study's Null hypothesis that ICT integration does not significantly impact on content assessment by ICT and Non-ICT trained teachers of secondary schools in Machakos County, Kenya. On the contrary, the study established that ICT integration significantly impacted on content assessment by ICT trained teachers and moderately impacted on content assessment by Non-ICT trained secondary school teachers in Machakos Count, Kenya. Hence the alternative hypothesis was accepted.

From this finding, the study concluded that ICT integration significantly impacted on teachers' content assessment by ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in content assessment was significantly higher at (p) 0.001 than for Non-ICT trained teachers at (p) 0.04. The study concluded that ICT trained teachers integrated ICT in their content assessment more than Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

4.9 Data analysis on the impact of ICT integration on teacher-learner interaction by teachers

The last objective of interest to the study was the impact of ICT combination on teacher-learner interaction by teachers in secondary schools.

4.9.1 Analysis of Principals', Teachers', and Students' views on teachers' use of ICT skills in teacher-learner interaction.

The school principals, teachers, and students were requested to show the level of their agreement or disagreement with statements related to teachers' use of ICT skills in teacher-learner interaction. They were asked to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The principals' responses were as summarized in Table 4.37.

Table 4.37 Principal's views on teachers' use of ICT skills in teacher-learner interaction

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use ICT to post lesson notes to students	10	10.4	20	20.8	32	33.3	34	35.5	0	0	7	11	26	40.6	31	48.4
Teachers use ICT to post students assignments	0	0	11	11.4	28	29.2	57	59.4	0	0	0	0	26	40.6	38	59.4
Teachers use ICT to post revision questions to students.	40	41.7	31	32.3	20	20.8	5	5.2	0	0	0	0	31	48.4	33	51.6
Teachers use ICT to conduct online question and answer interaction with students	20	20.8	37	38.6	29	30.2	10	10.4	0	0	14	21.8	20	31.2	30	47
Teachers use of ICT enabled online group discussions	0	0	4	4.2	39	40.6	53	55.2	0	0	0	0	39	60.9	25	39.1
Teachers use ICT to exchange students written work via internet, electronic mails, attachments and texts	0	0	15	15.6	41	42.7	40	41.7	0	0	5	7.7	29	45.3	30	47
Teachers use of ICT has enhanced online individualized interaction	0	0	20	20.8	27	28.2	49	51	0	0	0	0	30	47	34	53
Teachers use of ICT has enhanced one on one communication and rapport in the teaching and learning process	0	0	21	21.9	33	34.4	42	43.7	0	0	4	6.3	27	42.2	33	51.5
Teachers use of ICT has enhanced video conferencing amongst teachers and students	0	0	4	4.2	32	33.3	60	62.5	0	0	0	0	31	48.4	33	51.6
Teachers use of ICT has enabled skyping amongst teachers and students	0	0	0	0	46	47.9	50	52.1	0	0	0	0	30	47	34	53

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n =64. % = 100)

The analysis encompassed in Table 4.37 revealed that 10.4 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that teachers used ICT to post lesson notes to students, while none of the principals of schools with Non-ICT trained teachers strongly agreed with the statement. 20.8 percent of the

principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to post lesson notes to students compared to 11 percent of the principals of schools with Non-ICT trained teachers who agreed with the statement. To the contrary, 33.3 percent and 35.5 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to post lesson notes to students respectively, compared to 40.6 percent and 48.4 percent of the principals of schools with Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. None of the principals of either category strongly agreed with the statement that teachers used ICT to post students assignments. Similarly, none of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers used ICT to post students assignments compared to 11.4 of the principals of schools with ICT trained teachers who agreed with the statement. However, 29.2 percent and 59.4 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to post students assignments respectively, compared to 40.6 percent and 59.4 percent of the principals of schools with Non-ICT trained teachers who had similar views respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed or agreed with the statement that teachers used ICT to post revision questions to students, compared to 41.7 percent and 32.3 percent of the principals of schools with ICT trained teachers who strongly agreed and agreed with the statement respectively. Withal, 48.4 percent and 51.6 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to post revision questions to students respectively, compared to 20.8 percent

and 5.2 percent of the principals of schools with ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

The information indicated that 20.8 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that teachers used ICT to conduct online question and answer interaction with students, while none of the of the principals of schools with Non-ICT trained teachers strongly agreed with the statement. In addition, 38.6 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to conduct online question and answer interaction with students compared to 21.8 percent of their counterparts who felt the same. Similarly, 31.2 percent of the principals of schools with Non-ICT trained teachers and 30.2 percent of the principals of schools with ICT trained teachers disagreed with the statement that teachers used ICT to conduct online question and answer interaction. Further, 47 percent of the principals of schools with Non-ICT trained teachers strongly disagreed with the statement that teachers used ICT to conduct online question and answer interaction compared to 10.4 percent of their counterparts who strongly disagreed with the statement.

None of the principals of either category strongly agreed with the statement that teachers' use of ICT enabled online group discussions. 4.2 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers' use of ICT enabled online group discussions while none of their counterparts agreed with the statement. To the contrary, 40.6 percent and 55.2 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers' usage of ICT enabled online group discussions respectively, compared to 60.9 percent and 39.1 percent of the principals of schools with Non-ICT trained

teachers who disagreed and strongly disagreed with the statement respectively. Both categories of principals did not strongly agree with the statement that teachers used ICT to exchange students' written work via internet, electronic mails, attachments and texts. Nevertheless, 15.6 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to exchange students' written work via internet, electronic mails, attachments and texts compared to 7.7 percent of their counterparts who had similar views. Similarly, 42.7 percent and 41.7 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers used ICT to exchange students' written work via internet, electronic mails, attachments and texts respectively, compared to 45.3 percent and 47 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

None of the principals of either category strongly agreed with the statement that teachers' application of ICT enhanced online individualized interaction; 20.8 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers' use of ICT enhanced online individualized interaction while none of their counterparts agreed with the statement. However, 47 percent and 53 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that teachers' utilization of ICT enhanced online individualized interaction respectively, compared to 28.2 percent and 51 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

Similarly, none of the principals of either category strongly agreed with the statement that teachers' use of ICT had enhanced one on one communication and rapport in the teaching and learning practice. On the same statement, 21.9 percent of the principals

of schools that have teachers trained on ICT agreed that teachers' use of ICT had enhanced one on one communication and rapport in the teaching and learning process compared to 6.3 percent of their counterparts who had similar views. However, 34.4 percent and 43.7 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers' use of ICT had enhanced one on one communication and rapport in the teaching and learning process respectively, compared to 42.2 percent and 51.5 percent of the principals of schools with Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

All the principals of schools with ICT and Non-ICT trained teachers did not strongly agree with the statement that teachers' use of ICT had enhanced video conferencing amongst teachers and students. None of the principals of schools with Non-ICT trained teachers agreed with the statement that teachers' use of ICT had enhanced video conferencing amongst teachers and students compared to 4.2 percent of their counterparts who agreed with the statement. To the contrary, 33.3 percent and 62.5 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers' use of ICT had enhanced video conferencing amongst teachers and students respectively, compared to 48.4 percent and 51.6 percent of their counterparts who disagreed and strongly disagreed with the statement respectively. All the principals of schools with ICT and Non-ICT trained teachers did not strongly agree or agree with the statement that teachers' use of ICT had enabled skyping amongst teachers and students. However, 47.9 percent and 52.1 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that teachers' use of ICT had enabled skyping amongst

teachers and students respectively, compared to 47 percent and 53 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

From the analysis it is indicative that teachers' use of ICT skills in teacher-learner interaction was low for both ICT and Non-ICT trained teachers which influenced their pedagogical practices. The use of ICT to enable online group discussions and video conferencing amongst teachers and students was low for both ICT and Non-ICT trained teachers compared to the other teacher-learner interactive activities. The analysis also revealed that both ICT and Non-ICT trained teachers' use of ICT skills did not enable skyping among teachers and students. None of the principals of schools with Non-ICT trained teachers strongly agreed with any of the statements concerning teachers' use of ICT skills in teacher-learner interaction. This was an implication that Non-ICT trained teachers' lowly utilized technology to enhance their interaction with learners. This was due to lack of adequate skills to conduct learner interactive activities, inadequate and non-serviceable ICT equipment. This concurs with the findings of a case study of 18 secondary schools conducted by Magbagbeola (2012) in Nigeria which showed that Non-ICT trained teachers did not embrace the application of technologies in class activities which made teachers the transmitters of knowledge and students the recipients; this resulted to minimal class interactions and exchange of ideas, less students creativity and motivation, and poor teachers innovation which affected the quality of education and students' performance.

ICT trained teachers recorded a significant use of ICT skills in posting revision questions to students and conducting online question and answer interaction with students among others, due to the acquiring of relevant competencies in pedagogy ICT usage, adequacy and condition of ICT equipment in the schools.

The results echo a study conducted by Bertram and Waldrip (2013) in Australian secondary schools, which found that the use of digital resources, interactive instructional courseware, and multimedia applications by ICT trained teachers led to multi-sensory stimulation, exchange of students' written work, posting of questions and information via electronic mails, interactive learning environment, and intensified class room dialogue thus quality education.

The views of the teachers on their ICT application skills in teacher-learner interaction were also sought. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as represented in Table 4.38.

Table 4.38 Teachers views on their use of ICT skills in teacher-learner interaction

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Teachers use ICT to post lesson notes to students	50	23.8	47	22.4	63	30	50	23.8	0	0	20	14.3	59	42.1	61	43.6
Teachers use ICT to post student assignments	17	8.1	74	35.2	60	28.6	59	28.1	0	0	0	0	65	46.4	75	53.6
Teachers use ICT to post revision questions to students.	53	25.2	50	23.8	81	38.6	26	12.4	0	0	16	11.4	57	40.7	67	47.9
Teachers use ICT to conduct online question and answer interaction with students	31	14.8	60	28.6	40	19	79	37.6	0	0	10	7.1	63	45	67	47.9
Teachers use of ICT enabled online group discussions	0	0	74	35.2	70	33.3	66	31.5	0	0	0	0	55	39.3	85	60.7
Teachers use ICT to exchange students written work via internet, electronic mails, attachments and texts	20	9.5	48	22.9	62	29.5	80	38.1	0	0	16	11.4	57	40.7	67	47.9
Teachers use of ICT has enhanced online individualized interaction	22	10.5	50	23.8	60	28.6	78	37.1	0	0	10	7.1	55	39.3	75	53.6
Teachers use of ICT has enhanced one on one communication and rapport in the teaching and learning process	40	19	55	26.3	58	27.6	57	27.1	0	0	10	7.1	60	42.9	70	50
Teachers use of ICT has enhanced video conferencing amongst teachers and students	0	0	20	9.5	93	44.3	97	46.2	0	0	0	0	71	50.7	69	49.3
Teachers use of ICT has enabled skyping amongst teachers and students	0	0	0	0	110	52.4	100	47.6	0	0	0	0	69	49.3	71	50.7

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n =140. % = 100)

The analysis comprised in Table 4.38 showed that 23.8 percent of ICT trained teachers strongly agreed with the statement that they used ICT to post lesson notes to

students, while none of the Non-ICT trained teachers strongly agreed with the statement. 22.4 percent of ICT trained teachers agreed with the statement that they used ICT to post lesson notes to students compared to 14.3 percent of Non-ICT trained teachers who agreed with the statement. However, 42.1 percent and 43.6 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to post lesson notes to students respectively, compared to 30 percent and 23.8 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively. None of the Non-ICT trained teachers strongly agreed or agreed with the statement that they used ICT to post students assignments, compared to 8.1 percent and 35.2 percent of ICT trained teachers who strongly agreed and agreed with the statement respectively. To the contrary, 46.4 percent and 53.6 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to post students assignments respectively; 28.6 percent and 28.1 percent of ICT trained teachers disagreed and strongly disagreed with the statement respectively.

None of the Non-ICT trained teachers strongly agreed with the statement that they used ICT to post revision questions to students compared to 25.2 percent of ICT trained teachers who strongly agreed with the statement. On the same statement, 23.8 percent of ICT trained teachers agreed with the statement that they used ICT to post revision questions to students compared to 11.4 percent of Non-ICT trained teachers who agreed with the statement. To the contrary, 40.7 percent and 47.9 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to post revision questions to students respectively compared to 38.6 percent

and 12.4 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

All the Non-ICT trained teachers did not strongly agree with the statement that they used ICT to conduct online question and answer interaction with students compared to 14.8 percent of ICT trained teachers who strongly agreed with the statement. In addition, 28.6 percent of ICT trained teachers agreed with the statement that they used ICT to conduct online question and answer interaction with students compared to 7.1 percent of Non-ICT trained teachers who felt the same. However, 45 percent and 47.9 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to conduct online question and answer interaction with students respectively, compared to 19 percent and 37.6 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

None of the ICT and Non-ICT trained teachers strongly agreed with the statement that the use of ICT enabled online group discussions; 35.2 percent of ICT trained teachers agreed with the statement that the use of ICT enabled online group discussions while none of the Non-ICT trained teachers felt the same. Similarly, 33.3 percent of ICT trained teachers and 39.3 percent of Non-ICT trained teachers disagreed with the statement that the use of ICT enabled online group discussions respectively. Further, 60.7 percent of Non-ICT trained teachers strongly disagreed with the statement that the use of ICT enabled online group discussions compared to 31.5 percent of ICT trained teachers who had similar views.

None of the Non-ICT trained teachers strongly agreed with the statement that they used ICT to exchange students' written work via internet, electronic mails, attachments and texts compared to 9.5 percent of ICT trained teachers who strongly

agreed with the statement. 22.9 percent of ICT trained teachers agreed with the statement that they used ICT to exchange students' written work via internet, electronic mails, attachments and texts compared to 11.4 of Non-ICT trained teachers who agreed with the statement. However, 29.5 percent and 38.1 percent of ICT trained teachers disagreed and strongly disagreed with the statement that they used ICT to exchange students' written work via internet, electronic mails, attachments and texts respectively, compared to 40.7 percent and 47.9 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

Further, the information showed that 10.5 percent of ICT trained teachers strongly agreed with the statement that the use of ICT had enhanced online individualized interaction, while none of the Non-ICT trained teachers strongly agreed with the statement. 7.1 percent of Non-ICT trained teachers agreed with the statement that the usage of ICT had accelerated online individualized interaction in comparison to 23.8 percent of ICT trained teachers who had similar views. To the contrary, 28.6 percent and 37.1 percent of ICT trained teachers disagreed and strongly disagreed with the statement that the use of ICT had enhanced online individualized interaction respectively, compared to 39.3 percent and 53.6 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

Non-ICT of the trained teachers strongly agreed with the statement that the use of ICT had enhanced one on one communication and rapport in the teaching and learning exercise compared to 19 percent of ICT trained teachers who strongly agreed with the statement. In addition, 26.3 percent of ICT trained teachers agreed with the statement that the use of ICT had enhanced one on one communication and rapport in the teaching and learning procedure compared to 7.1 percent of Non-ICT trained teachers

who agreed with the statement. To the contrary, 42.9 percent and 50 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that the use of ICT had enhanced one on one communication and rapport in the teaching and learning process respectively, compared to 27.6 percent and 27.1 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

Similarly, none of the ICT and Non-ICT trained teachers strongly agreed with the statement that the use of ICT had enhanced video conferencing amongst teachers and students. 9.5 percent of ICT trained teachers agreed with the statement that the use of ICT had enhanced video conferencing amongst teachers and students while none of the Non-ICT trained teachers agreed with the statement. However, 44.3 percent and 46.2 percent of ICT trained teachers disagreed and strongly disagreed with the statement that the use of ICT had enhanced video conferencing amongst teachers and students respectively, compared to 50.7 percent and 49.3 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. None of the ICT and Non-ICT trained teachers strongly agreed and agreed with the statement that the use of ICT had enabled skyping amongst teachers and students. To the contrary, 52.4 percent and 47.6 percent of ICT trained teachers disagreed and strongly disagreed with the statement that the use of ICT had enabled skyping amongst teachers and students respectively, compared to 49.3 percent and 50.7 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

The analysis signified that ICT trained teachers' utilized ICT skills more in teacher-learner interaction, which enhanced posting of revision questions, and lesson notes to students, individualized interactions, and sharing of ideas due to the acquisition of

specialized ICT training on the application and development of ICTs for teaching and learning, and the adequacy of ICT tools. These findings mirror the assertion advanced by Yilmaz (2011) that the utilization of ICT in pedagogy by ICT trained teachers enhanced posting of revision questions and learning materials to students, individualized interactions, offered a platform for students to construct and share new ideas, improved one on one communication amongst students thus improved performance and quality of education.

Further, the analysis showed that Non-ICT trained teachers did not strongly agree with any statement regarding their incorporation of ICT skills in teacher-learner interaction. This implied that the use of ICT skills in teacher-learner interaction by Non-ICT trained teachers was insignificant compared to the other pedagogical practices. This could be associated to inadequate knowhow on the incorporation of ICT skills in pedagogy and insufficient ICT equipment in schools. This is in line with the findings of the study conducted by Khan, Hasan and Clement (2012) who established that Non-ICT trained teachers lacked the skills to use ICT tools to conduct online group discussions, online question and answer activities, exchange students work via internet and electronic mails which influenced classroom interaction, students' creativity, and motivation.

The findings further implied that ICT and Non-ICT trained teachers' use of ICT skills to enable video conferencing, online group discussions, and skyping amongst teachers and students was low compared to other aspects; none of the ICT and Non-ICT trained teachers indicated that the use of ICT had enabled skyping amongst teachers and students. In addition, the usage of ICT skills by ICT and Non-ICT trained teachers in teacher-learner interaction was low compared to the other pedagogical

practices. This could be associated to inadequacy and condition of ICT equipment, huge workload thus insufficient time to undertake some teacher-learner interactive activities which influenced their pedagogical practices. The findings support the work of Barak (2014) who alluded that employment of technology by ICT and Non-ICT trained teachers did not enable skyping and video conferencing amongst teachers and students as well as exchange of students' written work, ideas, and learning materials via internet due to insufficient time and broad curriculum limiting learner participation in classroom activities.

Similarly, the students were also asked to indicate their views on teachers' use of ICT skills in teacher-learner interaction. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The findings were as presented in Table 4.39.

Table 4.39 Students' views on teachers' use of ICT skills in teacher-learner interaction

Responses	SA		A		D		SD		TOTALS	
	n	%	n	%	n	%	n	%	N	%
Teachers use ICT to post lesson notes to students	87	22.9	95	25	98	25.8	100	26.3	**380**	**100**
Teachers use ICT to post assignments to student	74	19.5	89	23.4	107	28.2	110	28.9	**380**	**100**
Teachers use ICT to post revision questions to students.	99	26.1	80	21	101	26.6	100	26.3	**380**	**100**
Teachers use ICT to conduct online question and answer interaction with students	70	18.4	95	25	103	27.1	112	29.5	**380**	**100**
Teachers use of ICT enabled online group discussions	0	0	91	23.9	139	36.6	150	39.5	**380**	**100**
Teachers use of ICT has enhanced exchange of students written work via internet, electronic mails, attachments and texts	35	9.2	95	25	112	29.5	138	36.3	**380**	**100**
Use of ICT has enhanced online individualized interaction	42	11.1	87	22.9	110	28.9	141	37.1	**380**	**100**
Teachers use of ICT has enhanced one on one communication and rapport in the teaching and learning practice	86	22.6	98	25.8	93	24.5	103	27.1	**380**	**100**
Teachers' usage of ICT has enhanced video conferencing amongst teachers and students	0	0	40	10.5	163	42.9	177	46.6	**380**	**100**
Teachers use of ICT has enabled skyping amongst teachers and students	0	0	0	0	189	49.7	191	50.3	**380**	**100**

The data captured in Table 4.39 indicated that 22.9 percent and 25 percent of the students strongly agreed and agreed with the statement that both ICT and Non-ICT trained teachers used of ICT to post lesson notes respectively, compared to 25.8 percent and 26.3 percent of the students who disagreed and strongly disagreed with the statement respectively. Further, 19.5 percent and 23.4 percent of the students strongly agreed and agreed with the statement that teachers used ICT to post assignments to students respectively. However, 28.2 percent and 28.9 percent of the students disagreed and strongly disagreed with the statement respectively. In addition, 26.1 percent and 21 percent of the students strongly agreed and agreed with the statement that teachers used ICT to post revision questions to students respectively,

compared to 26.6 percent and 26.3 percent who disagreed and strongly disagreed with the statement respectively.

The analysis also showed that 18.4 percent and 25 percent of the students strongly agreed and agreed with the statement that teachers used ICT to conduct online question and answer interaction with students respectively. To the contrary, 27.1 percent and 29.5 percent of the students disagreed and strongly disagreed with the statement respectively. None of the students strongly agreed with the statement that teachers' use of ICT enabled online group discussions, while 23.9 percent agreed with the statement. However, 36.6 percent and 39.5 percent of the students disagreed and strongly disagreed with the statement that teachers' use of ICT enabled online group discussions respectively. In addition, 9.2 percent of the students strongly agreed with the statement that teachers' use of ICT had enhanced exchange of students' written work via internet, electronic mails, attachments and texts compared to 36.3 percent of the students who strongly disagreed with the statement. 25 percent of the students agreed with the statement that teachers' use of ICT had enhanced exchange of students' written work via internet, electronic mails, attachments and texts compared to 29.5 percent who disagreed with the statement.

Further, 11.1 percent of the students strongly agreed with the statement that teachers' use of ICT had enhanced online individualized interaction compared to 37.1 percent who strongly disagreed with the statement. Similarly, 22.9 percent of the students agreed with the statement that teachers' use of ICT had enhanced online individualized interaction, while 28.9 percent of the students disagreed with the statement. 22.6 percent and 25.8 percent of the students strongly agreed and agreed with the statement that teachers' use of ICT had enhanced one on one communication

and rapport in the teaching and learning process respectively, compared to 24.5 percent and 27.1 percent of the students who disagreed and strongly disagreed with the statement respectively.

None of the students strongly agreed with the statement that teachers' use of ICT had enhanced video conferencing amongst teachers and students compared to 46.6 of the students who strongly disagreed with the statement. In addition, 10.5 percent of the students agreed with the statement that teachers' use of ICT had enhanced video conferencing amongst teachers and students compared to 42.9 percent who disagreed with the statement. None of the students strongly agreed or agreed with the statement that both ICT and Non-ICT trained teachers' use of ICT had enabled skyping amongst teachers and students. To the contrary, 49.7 percent and 50.3 percent of the students disagreed and strongly disagreed with the statement that teachers' use of ICT had enabled skyping amongst teachers and students respectively.

This implied that the use of ICT skills by both ICT and Non-ICT trained teachers in teacher-learner interaction was low compared to the other pedagogical practices which influenced classroom interactions. This was due to inadequate and non-serviceable ICT equipment, huge workload thus insufficient time to undertake some teacher-learner interactive activities, and lack of formal ICT training on the part of Non-ICT trained teachers. Chisalita and Cretu (2012) argued that ICT integration in teacher-learner interaction by ICT and Non-ICT trained teachers enabled them to post revision materials, additional lesson notes, and assignments to students which elevated their involvement in the teaching and learning process alongside encouraging in-depth understanding of the subject content. Further a study by Arnseth and Hatlevik, (2010) on the influence of ICT on teacher-learner interaction in eight

secondary schools in Hong Kong found out that posting revision questions, assignments, and lesson notes to students by ICT and Non-ICT trained teachers promoted collaboration, created conducive learning environment, enhanced student-centered learning, and improved the quality of teaching and learning. All these studies attest the findings of this study.

4.9.2 Observation schedule on teacher-learner interaction by teachers

Further the researcher conducted an observation schedule to assess the level of teachers' use of ICT skills in teacher-learner interaction. The results were as shown in Table 4.40.

Table 4.40 Observation results on teachers' use of ICT skills in teacher-learner interaction

	ICT trained teachers						**Non-ICT trained teachers**					
Response	**ICT compliance**		**Non-ICT compliance**		**Total**		**ICT compliance**		**Non-ICT compliance**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**
Mailed student lesson notes	90	42.9	120	57.1	**210**	**100**	20	14.3	120	85.7	**140**	**100**
Mailed student assignments	85	40.5	125	59.5	**210**	**100**	0	0	140	100	**140**	**100**
Mailed revision questions	103	49	107	51	**210**	**100**	20	14.3	120	85.7	**140**	**100**
Online question and answer interaction with students	72	34.3	138	65.7	**210**	**100**	10	7.1	130	92.9	**140**	**100**
Online group discussions through exchange of students written work via internet, electronic mails, attachments and texts	70	33.3	140	66.7	**210**	**100**	0	0	140	100	**140**	**100**
Online individualized interaction	73	34.8	137	65.2	**210**	**100**	10	7.1	130	92.9	**140**	**100**
Online one on one communication and rapport	95	45.2	115	54.8	**210**	**100**	12	8.6	128	91.4	**140**	**100**
Online video conferencing amongst teachers and students	20	9.5	190	90.5	**210**	**100**	0	0	140	100	**140**	**100**
Online skyping amongst teachers and students	0	0	210	100	**210**	**100**	0	0	140	100	**140**	**100**

The analysis indicated in Table 4.36 on teachers' use of ICT skills in teacher-learner interaction showed that 42.9 percent of ICT trained teachers had track records of mailed students notes compared to 14.3 of Non-ICT trained teachers who had the same records. However, 85.7 percent of Non-ICT trained teachers did not have records of mailed students notes compared to 57.1 percent of ICT trained teachers who did not have records of mailed students' notes. None of the Non-ICT trained teachers had ICT compliant mailed student assignments compared to 40.5 percent of ICT trained teachers who had them; however, 59.5 percent of ICT trained teachers did not have ICT compliant mailed student assignments. In addition, 49 percent of ICT trained teachers had mailed revision questions compared to 14.3 percent of Non-ICT trained teachers who were found having the same ICT compliant documents. To the contrary, 51 of ICT trained teachers and 85.7 percent of Non-ICT trained teachers did not have ICT compliant mailed revision questions respectively.

The information also showed that 65.7 percent of ICT trained teachers and 92.9 percent of Non-ICT trained teachers did not conduct online question and answer interaction with students respectively, compared to 34.3 percent of ICT trained teachers and 7.1 percent of Non-ICT trained teachers who conducted online question and answer interaction with students respectively. None of the Non-ICT trained teachers conducted online group discussions through exchange of student's written work via internet, electronic mails, attachments and texts compared to 33.3 percent of ICT trained teachers who conducted online group discussions through exchange of student's written work via internet, electronic mails, attachments and texts; while 66.7 percent of ICT trained teachers did not.

Further, 34.8 percent and 45.2 percent of ICT trained teachers conducted online individualized interaction and online one on one communication with students respectively, compared to 7.1 percent and 8.6 percent of Non-ICT trained teachers who were found conducting the same respectively. To the contrary, 65.2 percent and 54.8 percent of ICT trained teachers were not found having track records of online individualized interaction and online one on one communication with students respectively, compared to 92.9 percent and 91.4 percent of Non-ICT trained teachers who were not found having the track records respectively. None of the Non-ICT trained teachers conducted online video conferencing amongst teachers and students compared to 9.5 percent of ICT trained teachers who conducted online video conferencing amongst teachers and students; withal, 90.5 percent of ICT trained teachers did not have records of the same. Both ICT and Non-ICT trained teachers were not found having evidence of online skyping amongst teachers and students.

This indicated that ICT trained teachers minimally employed ICT skills to enhance their interaction with the students compared to other pedagogical practices despite having formal ICT training which impacted on their collaboration with the students. This could be due to inadequate ICT equipment, lack of serviceable ICT equipment, and insufficient time to prepare classroom and online ICT interactive activities. The Non-ICT trained teachers lacked ICT pedagogical training which affected their ability to develop online based interactive class activities alongside inadequate ICT equipment, lack of serviceable ICT equipment, and insufficient time to prepare classroom ICT interactive activities. This concurs with the opinion held by Farrell and Rushby (2016) that the application of ICT tools by ICT trained teachers made it possible for them to conduct online question and answer sessions, online group

discussions, and student individualized interaction; this facilitated students to work in pairs, discuss divergent educational concepts and ideas, and discover new knowledge. In addition, Magbagbeola (2012) established that Non-ICT trained teachers were found to possess inadequate ICT skills to conduct online based interactive class activities which limited the teacher-learner rapport, students' motivation thus influencing pedagogical efficacy.

4.9.3 Document analysis on teacher-learner interaction

In addition to questionnaires and observation schedule the study further considered the use of document analysis guide for data triangulation purposes. The researcher sought to find out the availability of teachers' particulars for teacher-learner interaction and if they included ICT related resources. The findings were as presented in Table 4.41.

Table 4.41 Availability of teachers' particulars for teacher-learner interaction and inclusion of ICT related resources

	ICT trained teachers						Non-ICT trained teachers					
Response	**Yes**		**No**		**Total**		**Yes**		**No**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Mailed students lesson notes	90	42.9	120	57.1	**210**	**100**	20	14.3	120	85.7	**140**	**100**
Mailed students assignments	85	40.5	125	59.5	**210**	**100**	0	0	140	100	**140**	**100**
Mailed revision questions	103	49	107	51	**210**	**100**	20	14.3	120	85.7	**140**	**100**

The information contained in Table 4.41 indicated that 42.9 percent of ICT trained teachers had records of mailed students lesson notes compared to 14.3 percent of Non-ICT trained teachers who had similar records. However, 57.1 percent of ICT trained teachers did not have records of mailed students lesson notes compared to 85.7 percent of Non-ICT trained teachers who did not have records of mailed students'

lesson notes as well. In addition, 40.5 percent of ICT trained teachers had records of mailed students' assignments, while none of the Non-ICT trained teachers had the same particulars respectively. Withal, 59.5 percent of ICT trained teachers did not have records of mailed students' assignments. Further, 49 percent of ICT trained teachers had records of mailed revision questions compared to 14.3 percent of Non-ICT trained teachers who had records of mailed revision questions. To the contrary, 51 percent of ICT trained teachers did not have records of mailed revision questions compared to 85.7 percent of Non-ICT trained teachers who did not have the same particulars.

This implied that the availability of teachers' particulars for teacher-learner interaction and inclusion of ICT related resources differed amongst the ICT and Non-ICT trained teachers which influenced their pedagogical practices. The findings confirmed the views of the principals, teachers, students, and the observation schedule results on ICT and Non-ICT trained teachers' usage of ICT skills and equipment in teacher-learner interaction.

4.9.4 Hypothesis four testing and analysis

H_4 ICT integration does not significantly impact on teacher-learner interaction of ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

To determine the relationship between ICT integration and teacher-learner interaction a simple regression analysis test was conducted between teachers' use of ICT skills and responses from questions on teacher-learner interaction for both ICT and Non-ICT trained teachers. A correlation level (r) was calculated to establish the presence and level of correlation. The correlation level (r) was squared to obtain the coefficient of determination (r^2) which determined the degree of association between ICT

integration and teacher-learner interaction by ICT and Non-ICT trained teachers. The results were as captured in Table 4.42.

Table 4.42 Simple regression model summary on the impact of ICT integration on teacher-learner interaction of ICT and Non- ICT trained teachers

Model	(r)	(r^2)	Sig. (b)
ICT trained teachers	0.837	0.700	0.032
Non-ICT trained teachers	0.558	0.311	0.005

Significant at the 0.05 level (2-tailed) df= 1

(**a) Constant predictor: ICT integration (b) Dependent Variable: Teacher-Learner interaction**

The information analyzed in Table 4.42 showed that the coefficient of correlation between teachers' ICT integration and teacher-learner interaction for ICT trained teachers was strong at value 0.837. Similarly, the coefficient of determination (r^2) was 0.700 indicating a strong predictor level of ICT integration and teacher-learner interaction amongst ICT trained teachers. This analysis revealed that about 70% of the variation in teacher-learner interaction was accounted for by teachers' integration of ICT in their pedagogy.

The (r) value for Non-ICT trained teachers was at level 0.558 implying a moderate relationship between teachers ICT integration and their interaction with learners. The coefficient of determination (r^2) for Non-ICT trained teachers posted a weak ICT integration predictor level of 0.311. This indicated that 31.1% of teacher-learner interaction by Non-ICT trained teachers could be explained by the integration of ICT in their pedagogical practices.

The information presented in Table 4.42 showed that the significance level of teachers' integration of ICT and the level of teacher-learner interaction for ICT

trained teachers was highly significant at *p* level 0.032. This *p* level implied that there was a significant influence of ICT integration on teacher-learner interaction by ICT trained teachers. The significance levels also revealed that teachers' integration of ICT in pedagogy resulted to high levels of teacher-learner interaction by ICT trained teachers.

Similarly, the significant levels for Non-ICT trained teachers was found to be significant at *p* value of 0.05 implying that there was a limited significant influence of ICT integration on teacher-learner interaction by Non-ICT trained teachers. This output demonstrated that ICT integration moderately influenced teacher-learner interaction by Non-ICT trained teachers.

The information in Table 4.42 led to rejection of the study's Null hypothesis that ICT integration does not significantly impact on teacher-learner interaction of ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. On the contrary, the study established that ICT integration significantly impacted on teacher-learner interaction of ICT trained teachers and moderately impacted on teacher-learner interaction of Non-ICT trained teachers in secondary schools in Machakos County, Kenya. Therefore, the alternative hypothesis was accepted.

From this finding, the study concluded that teachers' integration of ICT in their pedagogical practices significantly impacted on teacher-learner interaction of ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in their interaction with learners was significantly higher at (p) 0.032 than for Non-ICT trained teachers at (p) 0.05. The study concluded that teachers' integration of ICT in their pedagogical practices significantly impacted on teacher-learner interaction of ICT trained teachers

remarkably than Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

4.9.5 Hypothesis five testing and analysis

H_5 ICT integration does not significantly impact on the combined pedagogical practices (content preparation, content delivery, content assessment, and teacher-learner interaction).

To determine the relationship between ICT integration and content preparation, content delivery, content assessment, and teacher-learner interaction, all the regressions were integrated and presented in Table 4.43.

Table 4.43 Regression model summary on the impact of ICT integration on content preparation, content delivery, content assessment, and teacher-learner interaction by ICT and Non-ICT trained teachers

Independent variable (Constant predictor)	Dependent variable	Teachers Category	(r)	(r^2) (a)	Sig. (b)
ICT integration	Teachers' content preparation	ICT trained	0.859	0.738	0.002
		Non-ICT trained	0.578	0.334	0.045
ICT integration	Teachers' content Delivery	ICT trained	0.851	0.724	0.003
		Non-ICT trained	0.568	0.323	0.047
ICT integration	Teachers' content Assessment	ICT trained	0.914	0.835	0.001
		Non-ICT trained	0.598	0.358	0.04
ICT integration	Teacher-learner interaction	ICT trained	0.837	0.700	0.032
		Non-ICT trained	0.558	0.311	0.05

Significant at the 0.05 level (2-tailed) df= 1

The information presented in table 4.43 revealed that the coefficient of correlation (r) which determined the strength of the relationship between ICT integration and teachers' pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) for ICT trained teachers was very strong at 0.859, 0.851, 0.914, and 0.837 respectively.

Similarly, the coefficient of determination (r^2) that explained the degree of association between ICT integration and teachers' pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) for ICT trained teachers were 0.738, 0.724, 0.835, and 0.700 respectively ranging between strong to very strong. This implied that there were high percentages of ICT trained teachers who integrated ICT in their pedagogical practices.

The values of (r) for Non-ICT trained teachers posted moderate relationship between ICT integration and teachers' pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) at 0.578, 0.568, 0.598, and 0.558 respectively. Likewise (r^2) levels that explained the degree of association between ICT integration and teachers' pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) of Non-ICT trained teachers were, 0.334, 0.323, 0.358, and 0.311 which indicated a weak level. This output implied that there were low percentages of Non-ICT trained teachers who integrated ICT in their pedagogical practices.

The significance levels of ICT integration and teachers' pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) for ICT trained teachers were all highly significant at 0.002, 0.003, 0.001, and 0.032 *p* values respectively. Similarly, the significance levels of ICT integration and teachers' pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) for Non-ICT trained teachers were moderate at 0.045, 0.047, 0.04, and 0.05 *p* values respectively. These implied that there was statistical influence of ICT integration on ICT and Non-ICT trained teachers' pedagogical practices though with variations.

The analysis revealed that ICT trained teachers ICT integration highly impacted on their pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) respectively. For Non-ICT trained teachers ICT integration moderately impacted on their pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) respectively. The data led to rejection of the study's Null hypothesis that ICT integration does not significantly impact on the combined pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

On the contrary, the study established that ICT integration significantly impacted on the combined pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) by ICT trained teachers and moderately impacted on the combined pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) by Non-ICT trained teachers in secondary schools in Machakos County, Kenya. Therefore, the alternative hypothesis was adopted.

From these findings, the study concluded that ICT integration significantly impacted on the combined pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) respectively by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya though with varying degree of significance.

The study concluded that ICT integration impacted on the combined teachers' pedagogical practices; (content preparation, content delivery, content assessment, and

teacher-learner interaction) among ICT trained teachers more than Non-ICT trained teachers in secondary schools in Machakos County, Kenya.

4.10 Analysis of other relevant data on ICT integration

Having established the impact of ICT integration on teachers' content preparation, content delivery, content assessment, teacher-learner interaction, and tested the study hypothesis; it was vital to analyze the importance of ICT integration on teachers' pedagogical practices and its impact on the quality of education which comprised the study's output.

4.10.1 Importance of ICT integration on teachers' pedagogical practices

The integration of ICT in pedagogy impacts on teachers' content preparation, content delivery, content assessment, and teacher-learner interaction. This interaction consequently forms the foundation of evaluating the impact of ICT integration on teachers' pedagogical practices, and on the entire educational process which formed the output of the study. Therefore, it was paramount for the study to analyze the importance of ICT integration on teachers' pedagogical practices. The study sought the views of the respondents regarding how ICT integration in pedagogy impacted on various pedagogical aspects of the teachers and students.

To this effect the principals were asked to indicate their degree of agreement or disagreement with statements on how ICT integration in pedagogy impacted on teachers' aspects of pedagogy. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as presented in Table 4.44.

Table 4.44 Principal's views on the importance of ICT integration on teachers' pedagogical practices

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
ICT integration increases teachers' creativity	59	61.5	18	18.8	12	12.5	7	7.2	10	15.6	17	26.5	25	39.1	12	18.8
ICT integration enhances teachers' innovation	84	87.5	16	12.5 .	0	0	0	0	40	62.5	11	17.2	10	15.6	3	4.7
ICT integration enhances teachers content preparations	44	45.8	24	25	14	14.6	14	14.6	23	35.9	19	29.7	12	18.8	10	15.6
ICT integration improves teacher-learner interaction	24	24.9	34	35.4	23	24	15	15.7	10	15.6	15	23.4	15	23.4	24	37.5
ICT integration enables access to new and variant information	48	50	48	50	0	0	0	0	30	46.9	32	53.1	0	0	0	0
ICT integration enriches teachers' methods of content delivery	45	46.9	29	30.2	14	14.6	8	8.3	24	37.5	20	31.3	10	15.6	10	15.6
ICT integration upgrades content assessment	44	45.8	34	35.4	12	12.5	6	6.3	20	31.2	16	25	16	25	12	18.8
ICT integration improves collaboration with students	26	27	23	24	24	25	23	24	20	31.2	19	29.7	12	18.8	13	20.3

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n =64. % = 100)

The analysis presented in Table 4.44 indicated that 61.5 percent and 18.8 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration increased teachers' creativity respectively, compared to 15.6 percent and 26.5 percent of the principals of schools with Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 12.5 percent and 7.2 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration

increased teachers' creativity respectively, compared to 39.1 percent and 18.8 percent of the principals of schools with Non-ICT trained teachers who felt the same respectively. None of the principals of schools with ICT trained teachers disagreed or strongly disagreed with the statement that ICT integration enhanced teachers' innovation, compared to 15.6 percent and 4.7 percent of their counterparts who disagreed and strongly disagreed with the statement respectively. Withal, 87.5 percent and 12.5 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration enhanced teachers' innovation respectively, compared to 62.5 percent and 17.2 percent of their counterparts who had similar views respectively.

Similarly, 45.8 percent and 25 percent of the principals of schools with ICT trained teachers, and 35.9 percent and 29.7 percent of the principals of schools with Non-ICT trained teachers strongly agreed and agreed with the statement that ICT integration enhanced teachers' content preparation respectively. However, 14.6 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration enhanced teachers' content preparation respectively compared to 18.8 percent and 15.6 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

In addition, 24.9 percent and 35.4 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration improved teacher-learner interaction respectively, compared to 15.6 percent and 23.4 percent of their counterparts who had similar views respectively. To the contrary, 23.4 percent and 37.5 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved

teacher-learner interaction respectively, compared to 24 percent and 15.7 percent of their counterparts who had similar views respectively.

Similarly, none of the principals of either category disagreed or strongly disagreed with the statement that ICT integration enabled access to new and variant information. Withal, 46.9 percent and 53.1 percent of the principals of schools with Non-ICT trained teachers strongly agreed and agreed with the statement that ICT integration enabled access to new and variant information respectively, while 50 percent of their counterparts strongly agreed and agreed with the statement respectively. Similarly, 46.9 percent of the principals of schools with ICT trained teachers and 37.5 percent of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that ICT integration enriched teachers' methods of content delivery respectively. Likewise, 30.2 percent of the principals of schools with ICT trained teachers and 31.3 percent of their counterparts agreed with the statement that ICT integration enriched teachers' methods of content delivery respectively. To the contrary, 14.6 percent and 8.3 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration enriched teachers' methods of content delivery respectively, compared to 15.6 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

The information indicated that 45.8 percent and 35.4 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration upgraded teachers' content assessment respectively, compared to 31.2 percent and 25 percent of the principals of schools with Non-ICT trained teachers who felt the same.

On the other hand, 12.5 percent and 6.3 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration upgraded teachers' content assessment respectively, compared to 25 percent and 18.8 percent of their counterparts who had similar views respectively.

Similarly, 31.2 percent and 29.7 percent of the principals of schools with Non-ICT trained teachers strongly agreed and agreed with the statement that ICT integration improved teachers' collaboration with students respectively; while 27 percent and 24 percent of their counterparts strongly agreed and agreed with the statement respectively. To the contrary, 25 percent and 24 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved teachers' collaboration with students respectively compared to 18.8 percent and 20.3 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

A greater percentage of the principals were in agreement with most of the statements. This signified that ICT integration in pedagogy greatly impacted and boosted the pedagogical practices of both ICT and Non-ICT trained teachers though variedly. Further it was established that ICT integration highly enhanced teachers' innovation and enabled access to new and variant information which heightened the pedagogical practices of ICT and Non-ICT trained teachers compared to other aspects. The study also revealed that ICT integration lowly improved teacher-learner interaction and collaboration with student for both ICT and Non-ICT trained teachers.

The findings confirm a study conducted by Alazam, (2013) on ICT and Non-ICT trained teachers in Malaysia which indicated that ICT trained teachers' utilization of ICT in their pedagogy increased class collaboration, teacher-learner interaction,

teachers' creativity, enabled access to new and variant information, and simplified content delivery. Further, the study established that Non-ICT trained teachers in some regions were reported to minimally utilize technology in their classroom activities resulting to low levels of learner motivation, teacher-learner interaction, content coverage and assessment hence lowering the quality of educational achievement and attainment by the learners (Alazam, 2014).

Further the teachers were requested to indicate their level of agreement regarding the impact of ICT integration on various teachers' aspects of pedagogy. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as indicated in Table 4.45.

Table 4.45 Teacher's views on the importance of ICT integration on their pedagogical practices

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
ICT integration increases teachers' creativity	126	60	42	20	25	11.9	17	8.1	42	30	43	30.7	28	20	27	19.3
ICT integration enhances teachers' innovation	179	85.3	31	14.7	0	0	0	0	45	32.2	65	46.4	27	19.3	3	2.1
ICT integration enhances teachers content preparations	92	43.8	50	23.8	38	18.1	30	14.3	53	38	45	32	22	16	20	14
ICT integration improves teacher-learner interaction	32	22.9	47	33.3	32	22.9	29	20.9	42	30	28	20	35	25	35	25
ICT integration enables access to new and variant information	96	45.7	114	54.3	0	0	0	0	69	49.3	71	50.7	0	0	0	0
ICT integration enriches teachers' methods of content delivery	97	46.2	76	36.2	20	9.5	17	8.1	52	37.1	43	30.7	24	17.1	21	15.1
ICT integration upgrades content assessment	84	40	99	47.1	27	12.9	0	0	50	35.7	34	24	36	26	20	14.3
ICT integration improves collaboration with students	59	28.1	53	25.2	50	23.8	48	22.9	25	18	21	15	56	40	38	27

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n=140. % = 100)

The data captured in Table 4.45 showed that 60 percent of ICT trained teachers strongly agreed with the statement that ICT integration increased teachers' creativity compared to 30 percent of Non-ICT trained teachers who strongly agreed with the statement. Similarly, 20 percent of ICT trained teachers and 30.7 percent of Non-ICT trained teachers agreed with the statements that ICT integration increased teachers' creativity respectively. However, 11.9 percent and 8.1 percent of ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration increased

teachers' creativity respectively, compared to 20 percent and 19.3 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. None of the ICT trained teachers disagreed or strongly disagreed with the statement that ICT integration enhanced teachers' innovation, compared to 19.3 percent and 2.1 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. However, 85.3 percent of ICT trained teachers strongly agreed with the statement that ICT integration enhanced teachers' innovation, compared to 32.2 percent of Non-ICT trained teachers who felt the same. In addition, 46.4 percent of Non-ICT trained teachers agreed with the statement that ICT integration enhanced teachers' innovation, compared to 14.7 percent of ICT trained teachers who had similar views.

Further, 43.8 percent and 23.8 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration enhanced teachers content preparation respectively, compared to 38 percent and 32 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. On the other hand, 16 percent and 14 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration enhanced teachers content preparation respectively, compared to 18.1 percent and 14.3 percent of ICT trained teachers who had similar views respectively.

Regarding the statement that ICT integration improved teacher-learner interaction; 22.9 percent of ICT trained teachers strongly agreed with the statement compared to 30 percent of Non-ICT trained teachers who indicated the same. 20 percent of Non-ICT trained teachers agreed with the statement that ICT integration improved teacher-learner interaction, compared to 33.3 percent of ICT trained teachers who felt the

same. To the contrary, 22.9 percent and 20.9 percent of ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved teacher-learner interaction respectively, compared to 25 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively. None of the ICT and Non-ICT trained teachers disagreed or strongly disagreed with the statement that ICT integration enabled access to new and variant information. Withal, 45.7 percent and 54.3 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration enabled access to new and variant information respectively, compared to 49.3 percent and 50.7 percent of Non-ICT trained teachers who had similar views respectively.

The information also indicted that 46.2 percent and 36.2 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration enriched teachers' methods of content delivery respectively, compared to 37.1 percent and 30.7 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 17.1 percent and 15.1 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration enriched teachers' methods of content delivery respectively, compared to 9.5 percent and 8.1 percent of ICT trained teachers who felt the same respectively.

Likewise, 40 percent of ICT trained teachers and 35.7 percent of Non-ICT trained teachers strongly agreed with the statement that ICT integration upgraded content assessment. 47.1 percent of ICT trained teachers agreed with the statement that ICT integration upgraded content assessment compared to 24 percent of Non-ICT trained teachers who indicated the same. To the contrary, 26 percent of Non-ICT trained teachers disagreed with the statement that ICT integration upgraded content

assessment compared to 12.9 percent of ICT trained teachers who had similar views. None of the ICT trained teachers strongly disagreed with the statement that ICT integration upgraded content assessment compared to 14.3 of Non-ICT trained teachers who strongly disagreed with the statement. Further, 28.1 percent and 25.2 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration improved collaboration with students respectively, compared to 18 percent and 15 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 40 percent and 27 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved collaboration with students respectively, compared to 23.8 percent and 22.9 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

The views of the teachers also confirmed those of the principals, with both ICT and Non-ICT trained teachers agreeing with most of the statements. This was an implication that ICT integration had a great impact on the pedagogical practices of both ICT and Non-ICT trained teachers though with variations. The results indicated that ICT integration by both ICT and Non-ICT trained teachers highly enhanced teachers' innovation and enabled access to variant information compared to the other practices. In addition, the results indicated that teacher-learner interaction and collaboration of teachers and students of both ICT and Non-ICT trained teachers was lowly influenced by ICT integration compared to the other practices. The utilization of ICT in pedagogy by ICT trained teachers highly influenced their teaching and learning practices which heightened the quality of education. Non-ICT trained

teachers applied their general ICT knowledge in their teaching activities which affected their pedagogy and the quality of education.

The results testify the study conducted by Heick (2016) in Zimbabwe, who found that secondary school teacher education institutions had incorporated ICT in their curricula to prepare ICT trained teachers conversant with ICT and e-learning. This intensified content preparation by teachers, upgraded students understanding, thinking skills and motivation, improved content delivery, elevated content assessment, and teacher-learner interaction, heightening the quality of education. Further studies established that Non-ICT trained teachers in South African schools lowly applied technology in their pedagogical operations which negatively imparted on their content preparation, content assessment, content coverage, and interaction with learners leading to decreased students' creativity, motivation, and participation in learning (Wallet & Beatriz, 2015).

4.10.2 Importance of ICT integration on students' learning

Further in order to establish the importance of ICT integration on teachers' pedagogical practices; the study also sought to investigate how the integration of ICT in pedagogy impacted on students learning. Therefore, the study sought the views of the principals, teachers, and students on how ICT integration in pedagogy impacted on various aspects of the students' learning.

The principals were asked to indicate their views on how ICT integration in pedagogy impacted on aspects of students' learning. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as summarized in Table 4.46.

Table 4.46 Principal's views on the importance of ICT integration on students' learning

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
ICT integration increases students' creativity	48	50	26	27.1	12	12.5	10	10.4	15	23.4	30	46.9	10	15.6	9	14.1
ICT integration enhances student's academic performance	37	38.5	33	33.4	16	16.7	10	11.4	23	35.9	20	31.3	10	15.6	11	17.2
ICT integration increases students' participation in learning	51	53.1	28	29.2	14	14.6	3	3.1	18	28.1	30	46.9	13	20.3	3	4.7
ICT integration improves teacher-learner interaction	24	25	34	35.4	24	25	14	14.6	11	17.2	16	25	18	28.1	19	29.7
ICT integration enables students access to new and variant information	48	50	48	50	0	0	0	0	31	48.4	33	51.6	0	0	0	0
ICT integration increases students' problem-solving skills	33	33.4	26	27	21	28.2	16	11.4	8	12.5	20	31.3	24	37.4	12	18.8
ICT integration helps students with learning difficulties to benefit	6	6.3	13	14.5	44	45.8	33	33.4	0	0	11	17.2	19	29.7	34	53.1
ICT integration improves collaborations with other students	33	33.4	34	35.4	17	17.7	12	12.5	8	12.5	16	25	24	37.5	16	25

Schools with ICT trained teachers (n =96. % =100)
Schools with Non-ICT trained teachers (n=64. % = 100)

The information captured in Table 4.46 revealed that 50 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that ICT integration increased students' creativity, compared to 23.4 percent of the principals of schools with Non-ICT trained teachers who agreed with the statement respectively. 46.9 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that ICT integration increased students' creativity, compared to 27.1

percent of their counterparts who had similar views. However, 12.5 percent and 10.4 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration increased students' creativity respectively, compared to 15.6 percent and 14.1 percent of their counterparts who disagreed and strongly disagreed with the statement respectively.

Similarly, 38.5 percent and 33.4 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration enhanced student's academic performance respectively; while 35.9 percent and 31.3 percent of the principals of schools with Non-ICT trained teachers also strongly agreed and agreed with the statement respectively. To the contrary, 16.7 percent and 11.4 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration enhanced student's academic performance respectively, compared to 15.6 percent and 17.2 percent of their counterparts who had similar views respectively.

The analysis indicated that 53.1 percent and 29.2 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration increased students' participation in the learning process respectively, compared to 28.1 percent and 46.9 percent of the principals of schools with Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 14.6 percent and 3.1 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration increased students' participation in the learning process respectively, compared to 20.3 percent and 4.7 percent of their counterparts who had similar views respectively.

Further, 25 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that ICT integration improved teacher-learner interaction, compared to 17.2 percent of the principals of schools with Non-ICT trained teachers who strongly agreed with the statement. In addition, 35.4 percent of the principals of schools with ICT trained teachers agreed with the statement that ICT integration improved teacher-learner interaction compared to 25 percent of their counterparts who felt the same. Withal, 28.1 percent and 29.7 percent of the principals of schools with Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved teacher-learner interaction respectively, compared to 25 percent and 14.6 percent of their counterparts who indicated the same respectively.

None of the principals of either category disagreed or strongly disagreed with the statement that ICT integration enabled students' access to new and variant information. However, 50 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration enabled students' access to new and variant information respectively, compared to 48.4 percent and 51.6 percent of their counterparts who strongly agreed and agreed with the statement respectively. 33.4 percent of the principals of schools with ICT trained teachers strongly agreed with the statement that ICT integration increased students' problem-solving skills compared to 12.5 of their counterparts who indicated the same. Similarly, 27 percent of the principals of schools with ICT trained teachers and 31.3 percent of the principals of schools with Non-ICT trained teachers agreed with the statement that ICT integration increased students' problem-solving skills respectively. To the contrary, 28.2 percent and 11.4 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT

integration increased students' problem-solving skills respectively, compared to 37.4 percent and 18.8 percent of their counterparts who had similar views respectively.

None of the principals of schools with Non-ICT trained teachers strongly agreed with the statement that ICT integration helped students with learning difficulties to benefit compared to 6.3 percent of the principals of schools with ICT trained teachers who strongly agreed with the statement. Similarly, 14.5 percent of the principals of schools with ICT trained teachers and 17.2 percent of their counterparts agreed with the statement that ICT integration helped students with learning difficulties to benefit respectively. To the contrary, 45.8 percent and 33.4 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration helped students with learning difficulties to benefit respectively, compared to 29.7 percent and 53.1 percent of their counterparts who indicated the same respectively.

Further, 33.4 percent and 35.4 percent of the principals of schools with ICT trained teachers strongly agreed and agreed with the statement that ICT integration improved collaboration with other students respectively, compared to 12.5 percent and 25 percent of the principals of schools with Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 17.7 percent and 12.5 percent of the principals of schools with ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved collaboration with other students respectively, compared to 37.5 percent and 25 percent of the principals of schools with Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

This implied that both ICT and Non-ICT trained teachers' integration of ICT in pedagogy influenced all the aspects of students learning though with variations. The analysis revealed that principals of both school categories felt that ICT integration greatly impacted on students' creativity, enhanced students' academic performance, participation in learning, and enabled students' access to new and variant information compared to other aspects of students learning. The results also implied that ICT integration by both ICT and Non-ICT trained teachers least helped students with learning difficulties to benefit. ICT integration by ICT trained teachers highly influenced the students learning because they had acquired ICT training which influenced their pedagogical practices compared to the Non-ICT trained teachers who lacked formal ICT training which influenced their incorporation of ICT in the teaching and learning process.

This supports the findings that, ICT trained teachers who had exposure to either pre-service or in-service ICT training demonstrated command on the adoption and integration of ICT in their teaching operations; consequently, these resulted to increased student's problem-solving skills, higher frequency of content assessment, access to expansive content and educational ideas, improved teacher-learner interactions, creativity and motivation amongst learners (Liu, 2011). Pruet, Ang & Farzin, (2014) found that Non-ICT trained teachers minimally utilized technology in their pedagogical practices resulting to decreased frequency of content assessment, inadequate class demonstrations, less interactive lessons and learner participation, poor communication and collaboration amongst students which affected the students' performance. All these studies concur with the findings of the study.

In addition, the study sought the views of the teachers on their extent of agreement with statements related to the importance of ICT integration on aspects of students' learning. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. Their responses were as presented in Table 4.47.

Table 4.47 Teacher's views on the importance of ICT integration on students' learning

	ICT trained teachers								Non-ICT trained teachers							
Response	**SA**		**A**		**D**		**SD**		**SA**		**A**		**D**		**SD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
ICT integration increases students' creativity	105	50	63	30	32	15.2	10	4.8	55	39.2	21	15	29	20.8	35	25
ICT integration enhances student's academic performance	73	52.1	42	30	20	14.3	3.7	5.7	42	30	37	26.4	35	25	26	18.6
ICT integration increases students' participation in learning	67	31.9	79	37.6	39	18.6	25	11.9	35	25	26	18.5	51	36.5	28	20
ICT integration improves teacher-learner interaction	50	23.8	76	36.2	50	23.8	34	16.2.	21	15	10	7.1	59	42.1	50	35.8
ICT integration enables students access to new and variant information	109	51.9	101	48.1	0	0	0	0	80	57.1	60	42.9	0	0	0	0
ICT integration increases students' problem-solving skills	74	35.2	70	33.4	40	19	26	12.2	20	14.3	55	39.2	35	25	30	21.5
ICT integration helps students with learning difficulties to benefit	11	7.9	21	15	60	42.9	48	34.2	0	0	13	9.3	92	65.7	35	25
ICT integration improves collaborations with other students	74	35.2	74	35.2.	43	20.3	19	9.3	26	18.5	30	21.5	53	37.9	31	22.1

ICT trained teachers (n = 210. % =100)
Non-ICT trained teachers (n =140. % = 100)

The results presented in Table 4.47 indicated that 50 percent and 30 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration increased student creativity respectively, compared to 39.2 percent and 15 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. To the contrary, 20.8 percent and 25 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration increased student creativity respectively, compared to 15.2 percent and 4.8 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively. 52.1 percent of ICT trained teachers strongly agreed with the statement that ICT integration enhanced student's academic performance compared to 30 percent of Non-ICT trained teachers who felt the same. Similarly, 30 percent of ICT trained teachers and 26.4 percent of Non-ICT trained teachers agreed with the statement that ICT integration enhanced student's academic performance respectively. However, 14.3 percent and 5.7 percent of ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration enhanced student's academic performance respectively, compared to 25 percent and 18.6 percent of Non-ICT trained teachers who indicated the same respectively.

The information revealed that, 31.9 percent and 37.6 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration increased students' participation in learning respectively, compared to 25 percent and 18.5 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. To the contrary, 36.5 percent and 20 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration increased students' participation in learning respectively, while 18.6 percent and 11.9

percent of ICT trained teachers had similar views respectively. Further, 23.8 percent of ICT trained teachers strongly agreed with the statement that ICT integration improved teacher-learner interaction compared to 15 percent of Non-ICT trained teachers who felt the same. 36.2 percent of ICT trained teachers agreed with the statement that ICT integration improved teacher-learner interaction compared to 7.1 percent of Non-ICT trained teachers who agreed with the statement. However, 42.1 percent and 35.8 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved teacher-learner interaction respectively, compared to 23.8 percent and 16.2 percent of ICT trained teachers who indicated the same respectively.

None of the ICT and Non-ICT trained teachers disagreed or strongly disagreed with the statement that ICT integration enabled student's access to new and variant information. Withal, 57.1 percent and 42.9 percent of Non-ICT trained teachers strongly agreed and agreed with the statement that ICT integration enabled student's access to new and variant information respectively, compared to 51.9 percent and 48.1 percent of ICT trained teachers who had similar views respectively. The data also indicated that 35.2 percent of ICT trained teachers strongly agreed with the statement that ICT integration increased students' problem-solving skills compared to 14.3 of Non-ICT trained teachers who felt the same. Similarly, 33.4 percent of ICT trained teachers and 39.2 percent of Non-ICT trained teachers agreed with the statement that ICT integration increased students' problem solving skills respectively. However, 25 percent and 21.5 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration increased students' problem

solving skills respectively, compared to 19 percent and 12.2 percent of ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

None of the Non-ICT trained teachers strongly agreed with the statement that ICT integration helped students with learning difficulties to benefit compared to 7.9 percent of ICT trained teachers who strongly agreed with the statement. 15 percent of ICT trained teachers agreed with the statement that ICT integration helped students with learning difficulties to benefit compared to 9.3 percent of Non-ICT trained teachers who had similar views. To the contrary, 42.9 percent and 34.2 percent of ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration helped students with learning difficulties to benefit respectively, compared to 65.7 percent and 25 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

Further, 35.2 percent of ICT trained teachers strongly agreed and agreed with the statement that ICT integration improved collaborations with other students respectively, compared to 18.5 percent and 21.5 percent of Non-ICT trained teachers who strongly agreed and agreed with the statement respectively. However, 37.9 percent and 22.1 percent of Non-ICT trained teachers disagreed and strongly disagreed with the statement that ICT integration improved collaborations with other students respectively, compared to 20.3 percent and 9.3 percent of Non-ICT trained teachers who disagreed and strongly disagreed with the statement respectively.

The results implied that ICT integration in pedagogy by ICT and Non-ICT trained teachers positively influenced the students learning process though with variations. The ICT trained teachers posted high percentages as a result of exposure to formal ICT training which enhanced their pedagogical practices thus impacting more on the

students learning. ICT integration by Non-ICT trained teachers lowly influenced students learning due to lack of relevant ICT skills for the successful integration of ICT in pedagogy. Further, the results indicated that both ICT and Non-ICT trained teachers' integration of ICT impacted more on students' creativity, academic performance, and participation in learning compared to other aspects of students learning. In addition, both ICT and Non-ICT trained teachers indicated that ICT integration lowly helped students with learning difficulties to benefit.

These findings are in line with Pruet, Ang and Farzin (2014) who found that the ICT trained teachers reported improvements in their lesson presentations, content preparation, intensified methods of assessing their learners, interactive classes; hence higher levels of educational attainments; whilst the Non-ICT trained teachers experienced challenges in choice of appropriate ICT tools and preparation of ICT based educational materials which led to less interactive classes, low frequency learner assessment thus low leaners participation in the teaching and learning practices.

Further the study sought the views of the students on their levels of agreement to statements concerning the importance of ICT integration on their learning. The students were asked to indicate how ICT integration in pedagogy influenced various aspects of their learning. They were requested to indicate their responses as; SA=Strongly Agree, A=Agree, D=Disagree, and SD=Strongly Disagree. The results were as indicated in Table 4.48.

Table 4.48 Student's views on the importance of ICT integration on their learning

Responses	SA		A		D		SD		Total	
	n	%	n	%	n	%	n	%	n	%
ICT integration increases students' creativity	129	33.9	137	36.1	76	20	38	10	**380**	**100**
ICT integration enhances students' academic performance	114	30	133	35	76	20	57	15	**380**	**100**
ICT integration increases students' participation in learning	110	28.9	118	31.1	95	25	57	15	**380**	**100**
ICT integration improves teacher-learner interaction	104	27.4	136	35.8	83	21.8	57	15	**380**	**100**
ICT integration enables access to new and variant information	274	72.1	106	27.9	0	0	0	0	**380**	**100**
ICT integration increases students' problem-solving skills	76	20	114	30	95	25	95	25	**380**	**100**
ICT integration improves collaboration with other students	76	20	91	23.9	114	30	99	26.1	**380**	**100**
ICT integration helps students with learning difficulties to benefit	38	10	76	20	76	20	190	50	**380**	**100**

The results contained in Table 4.48 indicated that the opinions of the students echoed those of the principals and teachers regarding the influence of ICT integration on students learning. 33.9 percent and 36.1 percent of the students strongly agreed and agreed with the statement that ICT integration by both ICT and Non-ICT trained teachers increased students' creativity respectively. However, 20 percent and 10 percent of the students disagreed and strongly disagreed with the statement that ICT integration by both ICT and Non-ICT trained teachers increased students' creativity respectively. Likewise, 30 percent and 35 percent of the students strongly agreed and agreed with the statement that ICT integration by teachers enhanced students' academic performance respectively, compared to 20 percent and 15 percent of the students who disagreed and strongly disagreed with the statement respectively.

Further, 28.9 percent of the students strongly agreed with the statement that ICT integration by both ICT and Non-ICT trained teachers increased students'

participation in learning, compared to 15 percent who strongly disagreed with the statement. 31.1 percent of the students agreed with the statement that ICT integration by teachers increased students' participation in learning, while 25 percent of the students disagreed with the statement. In addition, 27.4 percent and 35.8 percent of the students strongly agreed and agreed with the statement that ICT integration by both ICT and Non-ICT trained teachers improved teacher-learner interaction respectively, compared to 21.8 percent and 15 percent of the students who disagreed and strongly disagreed with the statement respectively. None of the students disagreed or strongly disagreed with the statement that ICT integration by ICT and Non-ICT trained teachers enabled access to new and variant information. However, 72.1 percent and 27.9 percent of the students strongly agreed and agreed with the statement that ICT integration by ICT and Non-ICT trained teachers enabled access to new and variant information respectively.

The data showed that 25 percent of the student disagreed and strongly disagreed with the statement that ICT integration by ICT and Non-ICT trained teachers increased their problem-solving skills respectively, compared to 20 percent and 30 percent of the students who strongly agreed and agreed with the statement respectively. In addition, 30 percent and 26.1 percent of the students disagreed and strongly disagreed with the statement that ICT integration by ICT and Non-ICT trained teachers improved collaboration with other students respectively, compared to 20 percent and 23.9 percent of the students who strongly agreed and agreed with the statement respectively. To the contrary, 20 percent and 50 percent of the students disagreed and strongly disagreed with the statement that ICT integration by both ICT and Non-ICT trained teachers helped students with learning difficulties to benefit respectively,

compared to 10 percent and 20 percent of the students who strongly agreed and agreed with the statement respectively.

From the analysis the students entirely felt that ICT integration by ICT and Non-ICT trained teachers intensely imparted on their creativity, participation in the learning process, academic performance, and access to new and variant information, thus boosting their learning and academic achievements. The students also felt that ICT integration by ICT and Non-ICT trained teachers lowly helped students with learning difficulties to benefit. This implied that ICT integration in teachers' pedagogical practices influenced positively students learning thus heightening the quality of education.

These results agree with findings from research done by Khan, Hasan and Clement, (2012) in Morocco who found that ICT trained teachers assimilated technology in their pedagogical practices which stimulated the students through creation of conducive learning atmosphere, raised interaction and collaboration levels within learners and teachers, magnified content coverage, assessment, and preparation techniques; thus, remodeling the quality of education. The Non-ICT trained teachers lacked expertise on technology use in their subject areas which embedded their efforts to employ ICT in their pedagogical processes; thus, limited access to educational materials and resources, and low learner assessment rates (Khan, Hasan & Clement, 2012).

From the analysis the study concluded that ICT integration on teachers' pedagogical practices greatly impacted on teachers' aspects of pedagogy and students learning among ICT and Non-ICT trained teachers in secondary schools though with variations thus heightening the quality of education.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarized the findings of the study, conclusions derived from the study findings, recommendations, and suggestions for further research.

Having summarized the entire study, the study presented the major findings of the study as per the objectives of the study.

5.2 Summary of the study

The aim of this study was to investigate the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya. The study was directed by four objectives which focused on the impact of ICT integration on content preparation, content delivery, content assessment, and teacher-learner interaction by ICT and Non-ICT trained teachers in secondary schools. The study reviewed relevant research literature and provided findings from previous studies on ICT integration in education and pedagogy depended on the objectives. The study employed a descriptive survey design.

The target population for the study comprised 99,128 respondents which included; 328 principals, 3,600 teachers and 95,200 students from the secondary schools in the 8 Sub-Counties of Machakos County. The study sampled; 180 principals, 360 teachers, and 398 students from the target population. The study embraced ratio proportionate sampling to get the sample size of the principals and teachers in each Sub-County. Random sampling and equal allocation methods were employed to choose the teachers and students in the sampled secondary schools.

Data was collected by use of questionnaires, observation schedule, and document analysis guide. Content validity of the research instruments was ascertained through detailed comparative studies on the subject and piloting of the instruments. To intensify the reliability of the instruments, test re-test, member check analysis, recording and re-recording methods were employed.

Data analysis was done by the application of Statistical Package for Social Sciences (SPSS) software where data was coded, fed into the computer, analyzed descriptively, and presented using frequency distribution tables. Responses from the observation schedule and document analysis guide were organized into themes and integrated with rest of the data for purposes of triangulation.

Pearson's Product Moment was used to ascertain the level, the strength and the direction of the association amid ICT integration and teachers' pedagogical practices. Pearson chi test was applied to present and interpret the inferential data. Pearson chi test was employed to determine the levels of significance of the relationship between ICT integration and teachers' pedagogical practices.

The study established that ICT trained teachers profoundly embraced the use of ICT skills to prepare e-based learning activities which enhanced their content preparation leading to more innovative lessons due to the acquisition of pedagogical ICT training. The study found that Non-ICT trained teachers lacked fundamental ICT skills to create multimedia based instructional materials like; PowerPoint presentations, sound/audio clips, video clips, and images for lessons which limited their integration of ICT in content preparation.

Further, the study revealed that ICT trained teachers used ICT to present PowerPoint, sound/audio clips, technology-based games, and draw diagrams which enriched their content delivery. The study also established that Non-ICT trained teachers were not exposed to formal ICT pedagogical training, thus they applied their general ICT knowledge hence inhibiting their technology utilization in presenting simulations and preparing PowerPoint's thus lowering the quality of content delivery.

The study further established that both ICT and Non-ICT trained teacher's utilized ICT to prepare continuous assessment tests (CATs), set examinations, and write Computer Studies examinations resulting to increased frequency of assessment, timely and authentic feedback which enhanced their pedagogical practices. The study found that all the schools lacked the ICT equipment for detecting plagiarism in students' essays which could be associated to lack of the relevant ICT equipment in the schools due to inadequacy of finances.

The study established that ICT trained teachers' utilized ICT skills more in teacher-learner interaction, which enhanced posting of revision questions, and lesson notes to students, online individualized interactions, and online question and answer interactions due to the acquisition of specialized ICT training on the application and development of ICTs for teaching and learning. The study also revealed that both ICT and Non-ICT trained teachers' use of ICT in teacher-learner interaction did not enable skyping amongst teachers and students.

Based on the findings, the study concluded that ICT integration impacted on the combined teachers' pedagogical practices (content assessment, content delivery, content preparation, and teacher-learner interaction) among ICT trained teachers more

than Non-ICT trained teachers in secondary schools. Hence the null hypothesis was rejected.

Based on the findings and conclusions the study recommended that, the Teachers Service Commission (TSC) should ensure that pedagogical ICT training and certification are a requirement for all teachers who join the teaching profession for integration of ICT in pedagogy. The Ministry of Education (MOE) should intensify ICT training in teacher training institutions to ensure that all secondary school teachers acquire the relevant ICT skills to fully integrate and use ICT in their pedagogical practices. Further research should be undertaken on the initiatives by the Kenya Institute of Curriculum Development (KICD) towards the development of e-learning curriculums for secondary schools in Kenya.

5.3 Major findings of the study

The following were the major findings of the study based on the research objectives.

5.3.1 Findings on the impact of ICT integration on content preparation by teachers

Based on data analysis and testing of hypothesis on objective one, the findings showed that ICT trained teachers profoundly embraced the use of ICT skills to prepare e-based learning activities which enhanced their content preparation leading to more innovative lessons due to the acquisition of pedagogical ICT training. The study established that 89.6 percent and 87.5 percent of the principals of schools with ICT trained teachers strongly agreed with the statements that teachers used ICT to write lesson notes and prepare records of work. 55.2 percent of the principals of schools with ICT trained teachers agreed with the statement that teachers used ICT to prepare PowerPoint presentations as indicated in Table 4.19. Similarly, 85.2 percent of ICT trained teachers strongly agreed with the statements that they used ICT to

write lesson notes and prepare records of work. 57.1 percent of ICT trained teachers strongly agreed with the statement that they used ICT to prepare PowerPoint presentations as indicated in Table 4.20. In addition, the observation results and document analysis showed that all the ICT trained teachers had ICT compliant lesson notes and records of work, while 170 percent had PowerPoint presentation slides as contained in Table 22 and Table 23 respectively.

The findings also showed that Non-ICT trained teachers lacked fundamental ICT skills to create multimedia based instructional materials like; PowerPoint presentations, sound/audio clips, video clips, and images for lessons which limited their integration of ICT in content preparation. This was as indicated by 51.5 percent of the principals of schools with Non-ICT trained teachers who strongly disagreed with the statements that teachers used ICT to prepare sound/audio clips, video clips, and images for lessons, while none agreed with the statement that teachers used ICT to prepare PowerPoint slides as presented in Table 4.19. Likewise, none of the Non-ICT trained teachers agreed with the statement that teachers used ICT to prepare PowerPoint presentations, while 50.7 percent strongly disagreed with the statements that they used ICT to prepare sound/audio clips, video clips, and images for lessons as presented in Table 4.20. In addition, the observation results and document analysis indicated that none of the Non-ICT trained teachers had PowerPoint slides, 15.7 percent had video clips, 8.6 percent had audio/sound clips, and 7.1 percent had images as contained in Table 22 and Table 23 respectively.

The study also established that both ICT and Non-ICT trained teachers used ICT to prepare their professional documents and personal smartphones and tablets to research lesson content and access educational materials from online sources to enhance their

content preparation. This was as indicated by 87.5 percent, 50 percent, and 41.7 percent of the principals of schools with ICT trained teachers strongly agreeing with the statements that teachers used ICT to prepare schemes of work, research lesson content and access educational materials from online data base respectively. Similarly, 59.4 percent, 47 percent and 54.8 percent of the principals of schools with Non-ICT trained teachers agreed with the statements that teachers used ICT to prepare schemes of work, research lesson content and access educational materials from online data base respectively as contained in Table 4.19. Likewise, 91.9 percent, 71.4 percent and 55.2 percent of ICT trained teachers strongly agreed with the statements that teachers used ICT to prepare schemes of work, research lesson content and access educational materials from online data base respectively, compared to 36.4 percent, 31.4 percent and 28.6 percent of Non-ICT trained teachers who strongly agreed with the statements respectively as indicated in Table 4.20. In addition, 28.9 percent and 26.8 percent of the students strongly agreed with the statement that ICT and Non-ICT used ICT to research lesson content and access educational materials from online data base respectively as contained in Table 4.21.

Further, the study established that there was a very strong relationship (r) 0.859 between ICT integration and ICT trained teachers' content preparation. The study established that there was a high significant influence of ICT integration on teachers' content preparation by ICT trained teachers at *p* level 0.002 a value lower than alpha 0.05. The relationship indicated that ICT integration resulted to high levels of use of ICT skills in content preparation by ICT trained teachers, as indicated in Table 4.24.

Further findings revealed that there was a moderate relationship between ICT integration and teachers' content preparation by Non-ICT trained teachers (r) (0.578).

The study established that there was moderate significant influence of ICT integration on Non-ICT trained teachers' content preparation at *p* level 0.045. This indicated that ICT integration impacted on Non-ICT trained teachers' content preparation though at a moderate level as indicated in Table 4.24.

The researcher further presented the major findings of the study based on the second research objective.

5.3.2 Findings on the impact of ICT integration on content delivery by teachers

In line with data analysis and hypothesis testing on objective two, the study established that ICT trained teachers used ICT to present PowerPoint, sound/audio clips, technology-based games, and draw diagrams which enriched their content delivery. This could be associated to the acquisition of pre-service and in-service ICT skills relevant for the development and adoption of ICTs in pedagogical practices. This study established that 41.7 percent, 51 percent, 62.5 percent, and 43.8 percent of the principals of schools with ICT trained teachers strongly agreed with the statements respectively as indicated in Table 4.25. Similarly, 71.4 percent, 85.2 percent, 51.9 percent of the ICT trained teachers strongly agreed with the statements respectively as contained in Table 4.26. In addition, 80.9 percent, 90 percent, 85.7 percent/90 percent, and 52.9 percent of the ICT trained teachers had the ICT particulars respectively as per the findings of the observation schedule and document analysis contained in Table 4.28 and Table 4.29.

The study also found that Non-ICT trained teachers were not exposed to formal ICT pedagogical training, thus they applied their general ICT knowledge hence inhibiting their technology utilization in presenting simulations and preparing PowerPoint's thus lowering the quality of content delivery; with none of the principals of schools with

Non-ICT trained teachers and Non-ICT trained teachers agreeing with the statements as presented in Table 4.25 and Table 4.26. None of the Non-ICT trained teachers had the ICT particulars according to the observation results and document analysis findings contained in Table 4.28 and Table 29.

Further, the findings of the study indicated that both ICT and Non-ICT trained teachers applied technology to present imagery resources, graphics, video clips, and present animations for efficient content delivery though with variations. The variations in usage could be associated with the levels of knowhow on the application of ICT skills in pedagogy by ICT and Non-ICT trained teachers, condition of the ICT equipment, adequacy of ICT equipment, inadequate time for preparation, resistance to change, and lack of relevant ICT skills by the Non-ICT trained teachers. The study established that 49 percent, and 42.7 percent of the principals of schools with ICT trained teachers agreed with the statements that teachers used ICT to present imagery resources, video clips, and animations in content delivery respectively, compared to 30 percent, 32.8 percent, and 31.2 percent of the principals of schools with Non-ICT trained teachers who agreed with the statements respectively as indicated in Table 4.25. Similarly, 72.8 percent, 64.8 percent, and 55.2 percent of ICT trained teachers strongly agreed with the statements respectively compared to 18.6 percent of Non-ICT trained teachers who agreed with the statements respectively as shown in Table 4.26. Likewise, 28.9 percent, 25.5 percent, and 23.7 percent of the students strongly agreed with the statements respectively as contained in Table 4.27.

The study further revealed that there was a strong relationship between ICT integration and teachers' content delivery (r) 0.851 for ICT trained teachers. The significance level of ICT integration in content delivery for ICT trained teachers was

extremely significant at *p* level 0.003. This showed that there was a high significant impact of ICT integration on teachers' content delivery by ICT trained teachers. The significance demonstrated that ICT integration resulted to high levels of use of ICT in content delivery by ICT trained teachers as indicated in Table 4.30.

Further, the study found out that there was a moderate relationship (r) 0.568 between ICT integration and teachers' content delivery by Non-ICT trained teachers. The significance levels for Non-ICT trained teachers were significant at *p* value 0.047 implying that there was moderate significant influence of ICT integration on the teachers' content delivery by Non-ICT trained teachers. This was an indication that ICT integration averagely impacted on Non-ICT trained teachers' content delivery as shown in Table 4.30.

Having presented the study findings based on the first and second objectives, the researcher further presented the findings of the study's third research objective.

5.3.3 Findings on the impact of ICT integration on content assessment by teachers

The data analysis and hypothesis testing for the third research objective showed that that both ICT and Non-ICT trained teacher's utilized ICT to prepare continuous assessment tests (CATs), set examinations, and write Computer Studies examinations resulting to increased frequency of assessment, timely and authentic feedback which enhanced their pedagogical practices. The study established that all of the principals of all school categories, all ICT and Non-ICT trained teachers, and all the students agreed with the statements respectively as presented in Table 4.31, Table 4.32, and Table 4.33.

The study also found that ICT trained teachers possessed the technological expertise to grade students' performance, track cumulative students' performance in examinations, and provide online feedback on students' performance in examinations which positively influenced their levels of content assessment. The study revealed that 62.5 percent, 55.2 percent, and 57.3 percent of the principals of schools with ICT trained teachers strongly agreed with the statements respectively as contained in Table 4.31. Similarly, 60.5 percent, 50.5 percent, and 55.2 percent of ICT trained teachers strongly agreed with the statements respectively as indicated in Table 4.32

Further, the study established that Non-ICT trained teachers possessed the basic ICT skills relevant for integrating technology in content assessment though some were unable to use ICT to compile examination performance reports for students using spreadsheets, track cumulative students' performance in examinations, and grade students' performance which influenced their pedagogy. The study found that 32.8 percent, 34.4 percent, and 31.2 percent of the principals of schools with Non-ICT trained teachers strongly disagreed with the statements respectively as shown in Table 4.31. Likewise, 35.7 percent, and 36.4 percent of Non-ICT trained teachers strongly disagreed with the statements respectively as indicated in Table 4.32.

The study revealed that all the schools lacked the ICT equipment for detecting plagiarism in students' essays which could be associated to lack of the relevant ICT equipment in the schools due to inadequacy of finances. This was in line with the views of the principals of all school categories, all ICT and Non-ICT trained teachers, and all students as indicated in Table 4.31, Table 4.32, and Table 4.33 respectively.

The study further revealed that there was a very strong relationship between ICT integration and teachers' content assessment for ICT trained teachers (r) 0.914. The level of significance of ICT integration in content assessment by ICT trained teachers was highly significant at *p* level 0.001. This implied that there was a remarkably high significant level of ICT integration on content assessment by ICT trained teachers as presented in Table 4.36.

Further findings indicated that Non-ICT trained teachers posted a moderate relationship of (r) 0.598 between ICT integration and their content assessment. The significance level for Non-ICT trained teachers was significant at *p* value 0.04. This demonstrated that there was a fairly significant impact of ICT integration on teachers' content assessment by Non-ICT trained teachers as presented in Table 4.36.

Finally, the researcher presented the major findings based on the fourth research objective.

5.3.4 Findings on the impact of ICT integration on teacher-learner interaction by teachers

Based on data analysis and hypothesis testing on the fourth objective, the study found that ICT trained teachers' utilized ICT skills more in teacher-learner interaction, which enhanced posting of revision questions, and lesson notes to students, online individualized interactions, and online question and answer interactions due to the acquisition of specialized ICT training on the application and development of ICTs for teaching and learning. The study revealed that 32.3 percent, 20.8 percent, 20.8 percent, and 38.6 percent of the principals of schools with ICT trained teachers agreed with the statements respectively as contained in Table 37. Similarly, 23.8 percent, 22.4 percent, 23.8 percent, and 28.6 percent of ICT trained teachers agreed with the statements respectively as contained in Table 38. Likewise, 49 percent, 42.9 percent,

34.8 percent, and 34.3 percent of the ICT trained teachers had the ICT particulars respectively as per the observation results contained in Table 4.40.

Further findings indicated that the use of ICT skills in teacher-learner interaction by Non-ICT trained teachers was low compared to the other pedagogical practices. None of the respondents strongly agreed with any of the statements concerning teachers' use of ICT skills in teacher-learner interaction. This was as per the views of the principals of schools with Non-ICT trained teachers and Non-ICT teachers as contained in Table 4.37 and Table 4.38.

Further, the study established that use of ICT to enable online group discussions and video conferencing amongst teachers and students was low for both ICT and Non-ICT trained teachers compared to the other teacher-learner interactive activities. The study established that none of the principals of schools with Non-ICT trained teachers agreed with the statements compared to 4.2 percent of their counterparts who agreed with the statement respectively as indicated in Table 4.37. Likewise, 19 percent and 9.5 percent of ICT trained teachers agreed with the statements while none of the Non-ICT trained teachers agreed with the statements as contained in Table 4.38. None of the students strongly agreed with the statements as shown in Table 4.39.

The study also revealed that both ICT and Non-ICT trained teachers' use of ICT in teacher-learner interaction did not enable skyping amongst teachers and students. This was as per the views of the principals, teachers, students, and observation results as presented in Table 4.37, Table 4.3, Table 4.39, and Table 4.40 respectively.

The study further established that the coefficient of correlation between teachers' ICT integration and teacher-learner interaction for ICT trained teachers was strong (r)

0.837. The significance level of teachers' integration of ICT and the level of teacher-learner interaction by ICT trained teachers was significant at *p* level 0.032. This implied that there was a reasonable impact of ICT integration on ICT trained teachers' interaction with learners as indicated in Table 4.42.

Further findings demonstrated that there was a moderate connection amongst ICT integration and teacher-learner interaction by Non-ICT trained teachers at (r) 0.558. The significance levels for Non-ICT trained teachers' integration of ICT and teacher-learner interaction were found to be significant at *p* value of 0.05. This output demonstrated that ICT integration moderately impacted on teacher-learner interaction by Non-ICT trained teachers as portrayed in Table 4.42.

Finally, the researcher presented the study findings on the importance of ICT merger on teachers' pedagogical exercises. This was vital for it contained the output of the study which gave a picture of the overall significance of integrating ICT in pedagogy; its impact on the teachers, students learning, and the quality of education.

5.3.5 Findings on the importance of ICT integration on teachers' pedagogical practices

In line with data analysis on the importance of ICT integration on teachers' pedagogical practices, the study revealed that ICT integration highly enhanced teachers' innovation and enabled ingress to new and different information which heightened the pedagogical practices of ICT and Non-ICT trained teachers compared to other aspects. The study established that 87.5 percent and 50 percent of the principals of schools with ICT trained teachers strongly agreed with the statements respectively compared to 62.5 percent and 46.9 percent of the principals of schools with Non-ICT trained teachers who had similar views respectively as contained in Table 4.44. Similarly, 85.3 percent of ICT trained teachers strongly agreed with the

statement that ICT integration enhanced teachers' innovation compared to 46.4 percent of Non-ICT trained teachers who agreed with the statement. None of the ICT and Non-ICT trained teachers disagreed with the statement that ICT integration enabled access to new and variant information respectively as shown in Table 4.45.

Further, the study established that ICT integration lowly improved teacher-learner interaction and teachers' collaboration with students for both ICT and Non-ICT trained teachers compared to the other practices. The study established that 15.7 percent and 24 percent of the principals of schools with ICT trained teachers strongly disagreed with the statements respectively compared to 35.7 percent and 20.3 percent of their counterparts who felt the same respectively as contained in Table 4.44. Likewise, 20.9 percent of ICT trained teachers and 25 percent of Non-ICT trained teachers strongly disagreed with the statement that ICT integration improved teacher-learner interaction respectively; while 23.8 percent of ICT trained teachers and 40 percent of Non-ICT trained teachers disagreed with the statement that ICT integration enhanced collaboration with students respectively as depicted in Table 4.45.

Further findings indicated that both ICT and Non-ICT trained teachers' incorporation of ICT impacted more on students' creativity, academic performance, and participation in learning compared to other aspects of students learning. The study found that 50 percent, 38.5 percent, and 53.1 percent of the principals of schools with ICT trained teachers strongly agreed with the statements respectively compared to 23.4 percent, 35.9 percent, and 28.1 percent of the principals of schools with Non-ICT trained teachers who had similar views respectively as contained in Table 4.46. In addition, 50 percent, 52.1 percent, and 31.9 percent of ICT trained teachers strongly agreed with the statements respectively compared to 39.2 percent, 30 percent, and 25

percent of Non-ICT trained teachers who had similar views respectively as indicated in Table 4.47. Further, 36.1 percent, 35 percent, and 31.1 percent of the students agreed with the statements respectively as contained in Table 4.48.

The study further established that both ICT and Non-ICT trained teachers ICT integration in pedagogy lowly helped students with learning difficulties to benefit. The study established that none of the principals of schools with Non-ICT trained teachers strongly agreed with the statement, compared to only 6.3 percent of the principals of schools with ICT trained teachers who strongly agreed with the statement as contained in Table 4.46. Similarly, only 7.9 percent of ICT trained teachers strongly agreed with the statement, while none of the Non-ICT trained teachers strongly agreed with the statement as indicated in Table 4.47. Further, 50 percent of the students strongly disagreed with the statement as shown in Table 4.48. These findings implied that ICT integration in teachers' pedagogy influenced positively students learning thus heightening the quality of education.

Having presented the major findings of the study, the researcher presented the conclusions drawn from the study findings.

5.4 Conclusions of the study

Based on the data analysis and hypothesis testing and the major findings of the study, the following conclusions were drawn.

With regard to objective one on the impact of ICT integration on content preparation by teachers; the study concluded that ICT integration significantly impacted on teachers' content preparation by ICT and Non-ICT trained teachers. ICT amalgamation to trained teacher's component to content preparation was significantly higher at (p) 0.002 than their Non-ICT trained counterparts at (p) 0.045.

It was concluded that ICT trained teachers integrated ICT in their content preparation more than Non-ICT trained teachers in secondary schools. Hence the null hypothesis was rejected.

Based on objective two on the impact of incorporation of ICT to content delivery by teachers; the study also concluded that ICT integration significantly impacted on teachers' content delivery by ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in their content delivery was significantly higher at (p) 0.003 than for Non-ICT trained teachers at (p) 0.047. The study concluded that ICT trained teachers integrated ICT in their content delivery greatly than Non-ICT trained teachers in secondary schools. Hence the null hypothesis was rejected.

Regarding objective three on the impact of ICT combination on content assessment by teachers; the study further concluded that ICT integration significantly impacted on teachers' content assessment by ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in content assessment was significantly higher at (p) 0.001 than for Non-ICT trained teachers at (p) 0.04. It was concluded that ICT trained teachers integrated ICT in their content assessment more than Non-ICT trained teachers in secondary schools. Hence the null hypothesis was rejected.

With regard to objective four on the impact of ICT integration on teacher-learner interaction by teachers; the study indeed concluded that ICT incorporation in their pedagogical practices significantly impacted on teacher-learner interaction of ICT and Non-ICT trained teachers. ICT trained teachers' integration of ICT in their interaction with learners was significantly higher at (p) 0.032 than for Non-ICT trained teachers at (p) 0.05. The study concluded that teachers' integration of ICT in their pedagogical practices significantly impacted on teacher-learner interaction of ICT trained teachers

remarkably than Non-ICT trained teachers in secondary schools. Consequently, the null hypothesis was rejected.

Regarding hypothesis five that ICT integration does not significantly impact the combined pedagogical practices; (content preparation, content delivery, content assessment, and teacher-learner interaction) by teachers. The study concluded that ICT integration impacted the combined teachers' pedagogical practices (content assessment, content delivery, content preparation, and teacher-learner interaction) among ICT trained teachers more than Non-ICT trained teachers in secondary schools. Hence the null hypothesis was rejected.

Based on other relevant findings; the study concluded that ICT integration on teachers' pedagogical practices greatly imparted on teachers' aspects of pedagogy and students learning among ICT and Non-ICT trained teachers in secondary schools though with variations thus heightening the quality of education.

After drawing the study's conclusions, the researcher presented the following recommendations based on the findings and conclusions of the study.

5.5 Recommendations from the study

Based on the major findings and conclusions of the study, the following recommendations were made:

i) The Ministry of Education (MOE) should intensify ICT training in teacher training institutions to ensure that all secondary school teachers acquire the relevant ICT skills to fully integrate and use ICT in their pedagogical practices.

ii) Teachers Service Commission (TSC) should ensure that pedagogical ICT training and certification are a requirement for all teachers who join the teaching profession for integration of ICT in pedagogy

iii) The Ministry of Education (MOE) and other educational training agencies should provide ICT in-service training programs to ensure that all teachers acquire ICT skills to utilize ICT in content preparation.

iv) The Ministry of Education (MOE) should adequately equip all the secondary schools with ICT equipment for full integration of ICT in education and pedagogy.

v) The Ministry of Education (MOE) and ICT development partners should ensure that all teachers acquire ICT proficiency for entire application of technology in content delivery.

vi) The Ministry of Education (MOE) and other ICT training agencies should ensure that all teachers are exposed to in-service ICT training to gain the technological expertise to incorporate ICT in content assessment for quality education.

vii) The Ministry of Education (MOE) and educational funders should provide adequate financial support to educational institutions to facilitate in-service ICT training for integration of ICT in teacher-learner interaction and improvement in the quality of education.

viii) Secondary school administrators should embrace the formulation of school ICT policies with distinct goals to guide the integration of ICT in pedagogy.

Besides the recommendations from the study, the researcher suggested areas for further research in relation to the study.

5.6 Suggestions for further research

Based on the major findings, conclusions, and recommendations from the study, the study made the following suggestions for further research;

i) Further studies on the initiatives undertaken by Kenya Institute of Curriculum Development (KICD**)** towards the development of e-learning curriculum for secondary schools in Kenya should be explored.

ii) Further studies should be done on the significance of ICT integration in pedagogy on students' educational achievements in secondary schools.

iii) Further comparative studies should be done in other counties on the influence of ICT integration on teachers' pedagogical practices in secondary schools.

iv) There is need to carry out a study on the determinants of teachers use of ICT in their pedagogical practices in secondary schools.

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APPENDIX I

LETTER OF INTRODUCTION

THE PRINCIPAL

_____ Secondary School,

Date: _____

Dear Sir/Madam

RE: DATA COLLECTION

I am a doctoral student at the University of Nairobi, Department of Educational Foundations. I am carrying out **A comparative study on the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya**. I kindly request you to permit me collect data from your school. I will be seeking to issue questionnaires to the principal, teachers, and students and conduct an observation schedule in the classes. Please be guaranteed that all the information provided will be confidential and will only be used for this research.

Thank you.

Yours faithfully,

ROSE M. KITHUNGU

APPENDIX II

QUESTIONNAIRE FOR SCHOOL PRINCIPALS

Dear respondent,

I am a doctoral student at the University of Nairobi, Department of Educational Foundations. I am carrying out a study on **A comparative study on the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.** I kindly request you to fill this questionnaire. Please indicate the correct option as correctly and sincerely as possible by ticking [√] on the options. For the questions that need your own opinion, use the space provided. Kindly do not write your name or the name of the institution on the questionnaire. Your identity will be accorded great confidentiality.

Please respond to all items

Section One: Demographic information

1. Kindly indicate the category of your school? National [ ] Extra-County [ ]
   County [ ] Sub-County [ ]
2. Kindly indicate your gender? Male [ ] Female [ ]
3. Kindly indicate your age? 21-30 years [ ] 31-40 years [ ]
   41-50 years [ ] Over 50 years [ ]
4. Kindly indicate your highest academic qualification?
   Diploma in Education [ ] Bachelor of Education (B.ED Arts) [ ]
   (B. ED Science) [ ] (B.ED IT) [ ] Masters of Education [ ] PhD [ ]
5. Kindly indicate your teaching experience? 0-5 years [ ] 6-10 years [ ]
   11-15 years [ ] 16-20 years [ ] Over 20 years [ ]

Section Two: ICT integration in teachers' pedagogy

6. Kindly indicate if teachers in your school have undergone formal ICT training?

Yes [ ] No [ ]

7. (i) Do you have an ICT policy in your school? Yes [ ] No [ ]

(ii) If yes, how influential is it in enhancing the schools' vision of integrating ICT in pedagogy? Very Influential [ ] Influential [ ]

Less influential [ ] Not influential [ ]

8. Kindly rate the adequacy of ICT equipment in your school?

	ICT EQUIPMENT	**VERY ADEQUATE**	**ADEQUATE**	**NOT ADEQUATE**
(i)	Internet availability			
(ii)	Smart phones			
(iii)	Digital cameras			
(iv)	Video cameras			
(v)	LCD projectors			
(vi)	Computers/ laptops			
(vii)	Tablets			
(viii)	Radios/TVs			
(ix)	White boards			
(x)	Smart boards			

9. Kindly rate the teachers' knowhow on the use of the following ICT software and equipment in pedagogy in your school?

	ICT SOFTWARE/EQUIPMENT	**VERY GOOD**	**GOOD**	**FAIR**
(i)	Microsoft word			
(ii)	Microsoft excel			
(iii)	Microsoft PowerPoint			
(iv)	Internet			
(v)	Smart phones			
(vi)	Digital cameras			
(vii)	Video cameras			
(viii)	LCD projectors			
(ix)	Computers/laptops			
(x)	Tablets			

10. By use of a [√] kindly rate the frequency of teachers' usage of the following ICT software and equipment in their pedagogical practices in your school?

	ICT SOFTWARE/EQUIPMENT	**Daily**	**Weekly**	**Monthly**	**Termly**
(i)	Microsoft word				
(ii)	Microsoft office excel				
(iii)	Microsoft PowerPoint				
(iv)	Internet (sourcing in formation)				
(v)	Smart phones				
(vi)	Digital cameras				
(vii)	Video cameras				
(viii)	LCD projectors (Lesson projection)				
(ix)	Computers/laptops				
(x)	Tablets				
(xi)	Whiteboards				
(xii)	Smart boards				
(xiii)	Radios/TVs				

Section Three: The impact of ICT integration on content preparation by teachers

11. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in content preparation in your school?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

Content preparation					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use ICT to prepare schemes of work				
(ii)	Teachers use ICT to write lesson plans				
(iii)	Teachers use ICT to write lesson notes				
(iv)	Teachers use ICT to prepare records of work				
(v)	Teachers use ICT to research lesson content				
(vi)	Teachers use ICT to access educational materials from online data base (E.g., Websites etc.)				
(vii)	Teachers use ICT to prepare power point presentations				
(viii)	Teachers use ICT to prepare sound/audio clips for lessons				
(ix)	Teachers use ICT to prepare video clips for lessons				
(x)	Teachers use ICT to prepare images for lessons				
(xi)	Teachers use ICT to prepare lesson attendance sheets				

Section Four: The impact of ICT integration on content delivery by teachers

12. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in content delivery in your school?

    Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

Content delivery					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use power point in lesson presentation				
(ii)	Teachers use ICT to present simulations for fast content delivery				
(iii)	Teachers use ICT to present imagery resources which ensures efficient content delivery				
(iv)	Teachers use ICT to present sound/audio clips in content delivery				
(v)	Teachers use ICT to present video clips for efficient content delivery				
(vi)	Teachers use ICT to present animations in content delivery				
(vii)	Teachers use ICT to present graphics that enhance content delivery				
(viii)	Teachers use ICT to draw diagrams to deliver content				
(ix)	Teachers use ICT to conduct classroom technology-based games				
(x)	Teacher use ICT to conduct role play teaching technique in content delivery				

Section Five: The impact of ICT integration on content assessment by teachers

13. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in content assessment in your school?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

Content assessment					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use ICT to prepare class assignments				
(ii)	Teachers use ICT to prepare continuous assessment tests (CATs) for students				
(iii)	Teachers use ICT in setting examinations				
(iv)	Teachers use ICT in writing Computer Studies examinations				
(v)	Teachers use ICT to compile examination performance reports for students using spreadsheets				
(vi)	Teachers use ICT to provide online feedback on students' performance in examinations				
(vii)	Teachers use ICT to track cumulative students' performance in examinations				
(viii)	Teachers use ICT in grading students' performance				
(x)	Teachers use ICT to check plagiarism in essays				

Section Six: The impact of ICT integration on teacher-learner interaction by teachers

14. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in teacher-learner interaction in your school?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

Teacher-learner interaction					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use ICT to post lesson notes to students				
(ii)	Teachers use ICT to post student assignments				
(iii)	Teachers use ICT to post revision questions to students.				
(iv)	Teachers use ICT to conduct online question and answer interaction with students				
(v)	Teachers use of ICT has enabled online group discussions				
(vi)	Teachers use ICT to exchange students written work via internet, electronic mails, attachments and texts				
(vii)	Teachers use of ICT has enhanced online individualized interaction				
(viii)	Teachers use of ICT has enhanced one on one communication and rapport in the teaching and learning process				
(ix)	Teachers use of ICT has enhanced video conferencing amongst teachers and students				
(x)	Teachers use of ICT has enabled skyping amongst teachers and students				

Section Seven: Importance of ICT integration on teacher's pedagogical practices

15. Kindly indicate your opinion regarding how ICT integration in pedagogy impacts on the following teachers' aspects in your school? Indicate by use of a tick [√] in the relevant column.

    Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

	Response	**SA**	**A**	**D**	**SD**
(i)	Increases teachers' creativity				
(ii)	Enhances teachers' innovation				
(iii)	Enhances teachers content preparation				
(iv)	Improves teacher-learner interaction				
(v)	Enables access to new and variant information				
(vi)	Enriches teachers' methods of content delivery				
(vii)	Upgrades content assessment				
(vii)	Improves collaboration with students				

16. Kindly indicate your opinion regarding how ICT integration in pedagogy impacts on the following aspects of students' learning in your school? Indicate by use of a tick [√] in the relevant column.

    Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

	Response	**SA**	**A**	**D**	**SD**
(i)	Increases students' creativity				
(ii)	Enhances student's academic performance				
(iii)	Increases students' participation in learning				
(iv)	Improves teacher-learner interaction				
(v)	Enables access to new and variant information				
(vi)	Increases students' problem-solving skills				
(vii)	Students with learning difficulties can benefit				
(viii)	Improves collaboration with other students				

THANKYOU FOR YOUR COOPERATION

APPENDIX III

QUESTIONNAIRE FOR TEACHERS

Dear respondent,

I am a doctoral student at the University of Nairobi, Department of Educational Foundations. I am carrying out **A comparative study on the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.** I kindly request you to fill this questionnaire. Please indicate the correct option as correctly and honestly as possible by putting a tick [√] on the options. For the questions that require your own opinion, use the space provided. Kindly do not write your name or the name of the institution on the questionnaire. Your identity will be accorded great confidentiality.

Please respond to all items

Section one: Demographic information

1. Kindly indicate the category of your school? National [ ] Extra-county [ ]
   County [ ] Sub-County [ ]
2. Kindly indicate your gender? Male [ ] Female [ ]
3. Kindly indicate your age? 21-30 years [ ] 31-40 years [ ]
   41-50 years [ ] Over 50 years [ ]
4. Kindly indicate your highest academic qualification?
   Diploma in Education [ ] Bachelor of Education (B.ED Arts) [ ]
   (B.ED Science) [ ] (B.ED IT) [ ] Masters of Education [ ] PhD [ ]
5. What is your teaching experience? 0-5 years [ ] 6-10 years [ ]
   11-15 years [ ] 16-20 years [ ] Over 20 years [ ]

Section Two: ICT integration in teachers' pedagogy

6. Have you undergone any formal ICT training? Yes [ ] No [ ]

7. (i) Do you have an ICT policy in your school? Yes [ ] No [ ]

(ii) If yes, how influential is it in enhancing the schools vision of integrating ICT in pedagogy? Very Influential [ ] Influential [ ]

Less influential [ ] Not influential [ ]

8. Kindly rate the adequacy of ICT equipment in your school?

	ICT EQUIPMENT	**VERY ADEQUATE**	**ADEQUATE**	**NOT ADEQUATE**
(i)	Internet availability			
(ii)	Smart phones			
(iii)	Digital cameras			
(iv)	Video cameras			
(v)	LCD projectors			
(vi)	Computers/ laptops			
(vii)	Tablets			
(viii)	Radios/TVs			
(ix)	White boards			
(x)	Smart boards			

9. By use of a [√] kindly rate your knowhow on the use of the following ICT software and equipment in the teaching and learning process?

	ICT SOFTWARE/EQUIPMENT	**VERY GOOD**	**GOOD**	**FAIR**
(i)	Microsoft word			
(ii)	Microsoft excel			
(iii)	Microsoft PowerPoint			
(iv)	Internet			
(v)	Smart phones			
(vi)	Digital cameras			
(vii)	Video cameras			
(viii)	LCD projectors			
(ix)	Computers/laptops			
(x)	Tablets			

10. Using the provided key kindly rate your frequency on the use of the following ICT software and equipment in your pedagogical practices?

	ICT SOFTWARE/EQUIPMENT	**Daily**	**Weekly**	**Monthly**	**Termly**
(i)	Microsoft office				
(ii)	Microsoft excel				
(iii)	Microsoft PowerPoint				
(iv)	Internet (sourcing in formation)				
(v)	Smart phones				
(vi)	Digital cameras				
(vii)	Video cameras				
(viii)	LCD projectors (Lesson projections)				
(ix)	Computers/ laptops				
(x)	Tablets				
(xi)	Whiteboards				
(xii)	Smart boards				
(xiii)	Radios/TVs				

Section Three: The impact of ICT integration on content preparation by teachers

11. Kindly by use of a tick [√] rate the extent of your agreement on your use of ICT skills in content preparation for teaching and learning?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

	Content preparation				
	Response	**SA**	**A**	**D**	**SD**
(i)	I use ICT to prepare schemes of work				
(ii)	I use ICT to write lesson plans				
(iii)	I use ICT to write lesson notes and work sheets				
(iv)	I use ICT to prepare records of work				
(v)	I use ICT to research lesson content				
(vi)	I use ICT to access educational materials from online data base (E.g., Websites)				
(vii)	I use ICT to prepare power point presentations				
(viii)	I use ICT to prepare sound/audio clips for lessons				
(ix)	I use ICT to prepare video clips for lessons				
(x)	I use ICT to prepare images for lessons				
(xi)	I use ICT to prepare lesson attendance sheets				

Section Four: The impact of ICT integration on content delivery by teachers

12. Kindly by use of a tick [√] rate the extent of your agreement on your use of ICT skills in content delivery in teaching and learning?

    Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

	Content delivery				
	Response	**SA**	**A**	**D**	**SD**
(i)	I use power point in lesson presentation				
(ii)	I use ICT to present simulations that ensure efficient content delivery				
(iii)	I use ICT to present imagery resources which ensures fast content delivery				
(iv)	I use ICT to present sound/audio clips in content delivery				
(v)	I use ICT to present video clips in content delivery				
(vi)	I use ICT to present animations for efficient content delivery				
(vii)	I use ICT to present graphics that enhance content delivery				
(viii)	I use ICT to draw diagrams for efficient content delivery				
(ix)	I use ICT to conduct classroom technology-based games				
(x)	I use ICT to conduct role play teaching technique in content delivery				

Section Five: The impact of ICT integration on content assessment by teachers

13. Kindly by use of a tick [√] rate the extent of your agreement on your use of ICT skills in content assessment in teaching and learning?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

Content assessment					
	Response	**SA**	**A**	**D**	**SD**
(i)	I use ICT to prepare continuous assessment tests (CAT) for students				
(ii)	I use ICT to prepare class assignments				
(iii)	I use ICT in setting examinations				
(iv)	I use ICT in writing Computer Studies examinations				
(v)	I use ICT to compile examination performance reports for students using spreadsheets				
(vi)	I use ICT to provide online feedback on students' performance in examinations				
(vii)	I use ICT to track cumulative students' performance in examinations				
(viii)	I use ICT to check plagiarism in essays				
(ix)	I use ICT in grading students' performance				

Section Six: The impact of ICT integration on teacher-learner interaction by teachers

14. Kindly by use of a tick [√] rate the extent of your agreement on your use of ICT skills in teacher-learner interaction in teaching and learning?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

Teacher-learner interaction					
	Response	**SA**	**A**	**D**	**SD**
(i)	I use ICT to post lesson notes to students				
(ii)	I use ICT to post assignments to student				
(iii)	I use ICT to post revision questions to students.				
(iv)	I use ICT to conduct online question and answer interaction with students				
(v)	Use of ICT has enabled online group discussions				
(vi)	Use of ICT has enhanced exchange of students written work via internet, electronic mails, attachments and texts				
(vii)	Use of ICT has enhanced online individualized interaction				
(viii)	Use of ICT has enhanced one on one communication and rapport in the teaching and learning process				
(ix)	Use of ICT has enhanced video conferencing with my students				
(x)	Use of ICT has enabled skyping with my students				

Section Seven: Importance of ICT integration on teachers' pedagogical practices

15. Kindly indicate your opinion regarding how ICT integration in pedagogy impacts on the following teachers' aspects in your school? Indicate by use of a tick [√] in the relevant column.

    Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

	Response	**SA**	**A**	**D**	**SD**
(i)	Increases teachers' creativity				
(ii)	Enhances teachers' innovation				
(iii)	Enhances teachers content preparation				
(iv)	Improves teacher-learner interaction				
(v)	Enables access to new and variant information				
(vi)	Enriches teachers' methods of content delivery				
(vii)	Upgrades content assessment				
(viii)	Improved collaboration with students				

16. Kindly indicate your opinion regarding how ICT integration in pedagogy impacts on the following aspects of students' learning in your school? Indicate by use of a tick [√] in the relevant column.

    Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

	Response	**SA**	**A**	**D**	**SD**
(i)	Increases students' creativity				
(ii)	Enhances student's academic performance				
(iii)	Increases students' participation in learning				
(iv)	Improves teacher-learner interaction				
(v)	Enables access to new and variant information				
(vi)	Increases students' problem-solving skills				
(vii)	Students with learning difficulties can benefit				
(viii)	Improved collaboration with other students				

THANKYOU FOR YOUR COOPERATION

APPENDIX IV

QUESTIONNAIRE FOR STUDENTS

Dear respondent,

I am a doctoral student at the University of Nairobi, Department of Educational Foundations. I am carrying out **A comparative study on the impact of ICT integration on teachers' pedagogical practices by ICT and Non-ICT trained teachers in secondary schools in Machakos County, Kenya.** I kindly request you to fill this questionnaire. Please indicate the correct option as correctly and honestly as possible by putting a tick [√] on the options. For the questions that require your own opinion, use the space provided. Kindly do not write your name or the name of the institution on the questionnaire. Your identity will be accorded great confidentiality.

Please respond to all items

Section one: Demographic information

1. Kindly indicate your gender? Male [ ] Female [ ]

2. Kindly indicate your age? 13- 16 years [ ] 17-19 years [ ] 20 – 25 years [ ]

3. Kindly indicate the category of your school? National [ ] Extra-county [ ]
County [ ] Sub-County [ ]

Section Two: ICT integration in teachers' pedagogy

4. By use of a tick [√] kindly rate the frequency of teachers' use of the following ICT software and equipment in the teaching and learning process?

	ICT SOFTWARE/EQUIPMENT	**Daily**	**Weekly**	**Monthly**	**Termly**
(i)	Microsoft word				
(ii)	Microsoft excel				
(iii)	Microsoft PowerPoint				
(iv)	Internet (sourcing in formation)				
(v)	Smart phones				
(vi)	Digital cameras				
(vii)	Video cameras				
(viii)	LCD projectors (Lesson projection)				
(ix)	Computers/ laptops				
(x)	Tablets				
(xi)	Whiteboards				
(xii)	Smart boards				
(xiii)	Radios/TVs				

The impact of ICT integration on content preparation by

5. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in content preparation in your school?

   Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

Content preparation					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use ICT to write lesson notes				
(ii)	Teachers use ICT to research lesson content				
(iii)	Teachers use ICT to access educational materials from online data base (E.g., Websites etc.)				
(iv)	Teachers use ICT to prepare power point presentations				
(v)	Teachers use to prepare sound/audio clips for lessons				
(vi)	Teachers use ICT to prepare video clips for lessons				
(vii)	Teachers use ICT to prepare images for lessons				

Section Four: The impact of ICT integration on content delivery by teachers

6. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in content delivery in your school?

   Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

Content delivery					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use power point in lesson presentation				
(ii)	Teachers use ICT to present simulations for fast content delivery				
(iii)	Teachers use ICT to present imagery resources which ensures efficient content delivery				
(iv)	Teachers use ICT to present sound/audio clips in content delivery				
(v)	Teachers use ICT to present video clips to deliver content				
(vi)	Teachers use ICT to present animations for efficient content delivery				
(vii)	Teachers use ICT to present graphics that enhance content delivery				
(viii)	Teachers use ICT to draw diagrams to enhance content delivery				
(ix)	Teachers use ICT to conduct classroom technology-based games				
(x)	Teachers use ICT to conduct role play teaching technique in content delivery				

Section Five: The impact of ICT integration on content assessment by teachers

7. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in content assessment in your school?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

Content assessment					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use ICT to prepare continuous assessment tests (CAT)				
(ii)	Teachers use ICT to prepare class assignments				
(iii)	Teachers use ICT in setting examinations				
(iv)	Students use ICT in writing Computer Studies examinations				
(v)	Teachers use ICT to compile examination performance reports for students using spreadsheets				
(vi)	Teachers use ICT to provide online feedback on students' performance in examinations				
(vii)	Teachers use ICT to track cumulative students' performance in examinations				
(viii)	Teachers use ICT to check plagiarism in students' essays				

Section Six: The impact of ICT integration on teacher-learner interaction by teachers

8. By use of a tick [√] kindly indicate the extent of your agreement on teachers' use of ICT skills in teacher-learner interaction in your school?

Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**)

Teacher-learner interaction					
	Response	**SA**	**A**	**D**	**SD**
(i)	Teachers use ICT to post lesson notes to students				
(ii)	Teachers use ICT to post assignments to student				
(iii)	Teachers use ICT to post revision questions to students.				
(iv)	Teachers use ICT to conduct online question and answer interaction with students				
(v)	Teachers use of ICT has enabled online group discussions				
(vi)	Teachers use of ICT has enhanced exchange of students written work via internet, electronic mails, attachments and texts				
(vii)	Teachers use of ICT has enhanced online individualized interaction				
(viii)	Teachers use of ICT has enhanced one on one communication and rapport in the teaching and learning process				
(ix)	Teachers use of ICT has enhanced video conferencing amongst teachers and students				
(x)	Teachers use of ICT has enabled skyping amongst teachers and students				

Section Seven: Importance of ICT integration on teacher's pedagogical practices

9. Kindly indicate your opinion regarding how ICT integration in pedagogy impacts on the following aspects of students' learning in your school? Indicate by use of a tick [√] in the relevant column.

   Key: Strongly Agree (**SA**) Agree (**A**) Disagree (**D**) Strongly Disagree (**SD**).

	Response	**SA**	**A**	**D**	**SD**
(i)	Increases students' creativity				
(ii)	Enhances student's academic performance				
(iii)	Increases students' participation in learning				
(iv)	Improves teacher-learner interaction				
(v)	Enables access to new and variant information				
(vi)	Increases students' problem-solving skills				
(vii)	Improves collaboration with other students				
(viii)	Students with learning difficulties can benefit				

THANKYOU FOR YOUR COOPERATION

APPENDIX V

OBSERVATION SCHEDULE

1. Section One: Usage of ICTs in teachers' pedagogy

Use of the listed ICT software/equipment by teachers

	ICT SOFTWARE/EQUIPMENT	**USED**	**NOT USED**
(i)	Microsoft word		
(ii)	Microsoft excel		
(iii)	Microsoft PowerPoint		
(iv)	Internet		
(v)	Smart phones		
(vi)	Digital cameras		
(vii)	Video cameras		
(viii)	LCD projectors		
(ix)	Computers/laptops		
(x)	Tablets		

2. Section Two: Teacher content preparation documents

	Particulars	**ICT compliance**	**Non-ICT compliance**
(i)	Lesson plan		
(ii)	Schemes of work		
(iii)	Students' worksheets		
(iv)	Lesson notes		
(v)	Records of work		
(vi)	PowerPoint slides		
(vii)	Video clips/Visual clips		
(viii)	Simulation clips		
(ix)	Games and Role play clips		
(x)	Audio clips		
(xi)	Images		

3. Section Three: Teacher content delivery particulars

	Particulars	**ICT compliance**	**Non-ICT compliance**
(i)	Soft copy of diagrams		
(ii)	Simulation clips		
(iii)	Audio clips		
(iv)	Video clips		
(v)	PowerPoint slides		
(vi)	Animation clips		
(vii)	Games and Role play clips		
(viii)	Graphic clips		

4. Section Four: Teacher assessment particulars

	Particulars	**ICT compliance**	**Non-ICT compliance**
(i)	Score spreadsheets		
(ii)	Typed examinations		
(iii)	Typed assignments		
(iv)	Typed continuous assessment tests (CATs)		
(v)	Students progressive record reports		
(vi)	Analyzed results		

5. Section Five: Teacher-Learner interaction documents/activities

	Particulars	**ICT compliance**	**Non-ICT compliance**
(i)	Mailed student lesson notes		
(ii)	Mailed student assignments and homework		
(iii)	Mailed revision questions		
(iv)	Online question and answer interaction with students		
(v)	Online group discussions through exchange of students written work via internet, electronic mails, attachments and texts		
(vi)	Online individualized interaction		
(vii)	Online one on one communication		
(viii)	Online video conferencing amongst teachers and students		

APPENDIX VI

DOCUMENT ANALYSIS GUIDE

1. Check store ledgers and inventories to establish the condition of the listed ICT equipment in schools.

	ICT EQUIPMENT	**SERVICEABLE**	**NOT SERVICEABLE**
(i)	Computers/laptops		
(ii)	Tablets		
(iii)	Digital pens		
(iv)	Internet		
(v)	Smart phone		
(vi)	Digital cameras		
(vii)	Video cameras		
(viii)	LCD projectors		
(ix)	Radios/TVs		
(x)	White boards		
(xi)	Smart boards		

2. Check if teachers' particulars for lesson preparation, content delivery, content assessment, and teacher-learner interaction are available and if they include ICT related resources. Fill in the table below.

	Teachers' particulars	**Availability and inclusion of ICT related resources (YES/NO)**
(i)		
(ii)		
(iii)		
(iv)		
(v)		

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/19/1105/27966**

Date: **1st February, 2019**

Rose Mwikali Kithungu
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Influence of ICT integration on teachers pedagogical practices in secondary schools. The case of ICT and Non-ICT trained teachers in Machakos County Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Machakos County** for the period ending **1st February, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Machakos County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

DR. MOSES RUGUTT, PHD, OGW
DIRECTOR GENERAL/CEO

Copy to:

The County Commissioner
Machakos County.

The County Director of Education
Machakos County.

THIS IS TO CERTIFY THAT:
MS. ROSE MWIKALI KITHUNGU
of UNIVERSITY OF NAIROBI, 585-90100
MACHAKOS,has been permitted to
conduct research in *Machakos County*

Permit No : NACOSTI/P/19/1105/27966
Date Of Issue : 1st February,2019
Fee Recieved :Ksh 2000

on the topic: *INFLUENCE OF ICT INTEGRATION ON TEACHERS PEDAGOGICAL PRACTICES IN SECONDARY SCHOOLS THE CASE OF ICT AND NON-ICT TRAINED TEACHERS IN MACHAKOS COUNTY KENYA*

for the period ending:
1st February,2020

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
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